THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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	Page
Commercial Morality	457
The Price of Rubber	458
National Physical Laboratory	458
The Workmen's Compensation Act	458
British Science	459
Copper	459
Past and Present: From £25 to £6,000 per Week	459
Correspondence:—	
Contractor or Manufacturer?	460
Protection and the Electrical Industry	460
Patching Poles	460
Publicity Literature	460
Emigration	461
Institution of Mining Electrical Engineers	461
The Electrical Industry and a New Organisation	461
Municipal Appointment	461
The Ontario Government Transmission System (*illus.*)	462
Legal	462
Parliamentary	463
New Electrical Devices, Fittings and Plant (*illus.*)	463
Overhead Wires and the Law	464
Safety in Handling High-Tension Gear	465
Our Canals	466
Some German Ozone Apparatus (*illus.*)	467
Business Notes	469
Notes	475
City Notes	480
Electric Tramway and Railway Traffic Returns	484
Stocks and Shares	484
Share List of Electrical Companies	485
Trade Statistics of Cape Colony	487
Meter-Reading Cards and Consumers' Ledgers	487
The Loading of Telephone Cable Circuits (*illus.*) (*continued*)	489
Reviews	490
Proceedings of Institutions:—	
Short-Circuiting of Large Electric Generators and the Resulting Forces on Armature Windings (*illus.*)	492
New Patents Applied For, 1910	496
Published Specifications	496
Contractors' Column	Advertisement pages 54 and 56

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COMMERCIAL MORALITY.

A PAPER which has recently been read before the American Society of Civil Engineers by Mr. John Hawkesworth deals with a subject of more than American interest. Its title is "Precarious Expedients in Engineering Practice," and its object is to expose and stop practices which, the author states, are not uncommon in American commercial life.

The paper details the procedure which is common in the conduct of large engineering works in America. There is first the selection of a "designer" responsible for the design and execution of the whole work—paid either by a percentage on the contract amount or by an agreed lump sum—and, secondly, the granting of the actual contract to a general contractor, whose offer may be the lowest, for the carrying-out of the requirements of the "designer's" specification.

The work may be of a comprehensive character, and the "designer," however gifted, may only be an expert in some —not in all—of the branches of work included in the contract. He is asked by experienced manufacturers if they can help him in the preparation of those parts of the scheme with which they are more particularly conversant, and after pointing out that his availing himself of their offer will in no way fetter his judgment, the "designer" consents. The manufacturers prepare drawings and often draft specifications, and without in any way binding the "designer" to any particular apparatus, they are of very great assistance, though, as the author points out, they rarely go out of their way to suggest the deletion of any unnecessary requirements which the "designer" may have inadvertently included in his drafts.

This preliminary knowledge of a specification often enables a manufacturer to prepare a low tender, which is accepted by both main contractor and "designer." After the work has been started this manufacturer, knowing that some of the requirements are unnecessary, offers to carry out his work in a simpler and more efficient manner than that detailed in the specification. The "designer," after careful inquiry, is convinced that this can be done without detriment to the whole contract, and in agreeing asks what rebate will be allowed for the omitted work. The sub-contractor, after a careful study of the whole specification with the principal contractor, discovers that some essential details in the carrying-out of the work have been omitted from the specification. True, there is in the General Conditions a comprehensive clause obliging the contractor to supply everything, whether specified or not; but the American Courts are not very favourable to a too literal interpretation of such a clause.

The next development is the pointing-out to the "designer" of the respects in which the specification is defective, and the submission of a claim for an extra payment for the omitted portion of the work. This is resisted by the

"designer," and it is only after threats of delay and litigation that he consents to recommend to the owner a compromise whereby omitted work is done, and unnecessary work remitted, without any alteration of the contract sum—an arrangement which in the vast majority of cases works out to the benefit of the contractors, who thereby secure a higher rate of profit than that provided for in their original tender.

The author gives specific instances in which some such plans have been worked for individual profit by interested persons both in private and in municipal contracts, and thereby the "designer" has been placed in positions of extreme difficulty without any wilful act of dishonesty on his own part. He then attacks the system under which such proceedings are possible, and advocates a series of reforms which would do much to maintain the real independence of the "designer." Amongst these are the payment of a sufficiently large fee, so that the offer of help to a "designer" by a manufacturer before the issue of a specification can be declined, and the prior arrangement between "designer" and owner of the names and remuneration of all experts whose assistance will be called in while the specification is in course of preparation. It is also suggested that the payment of a larger percentage of the total fee shall be made during the early stages of the work, when the expenses of the "designer" are a maximum while the benefit to the owner may be a minimum.

The appeal of the author to the better qualities of his hearers was thoroughly praiseworthy, and not only in the United States, but here at home, it might, by some such reforms in procedure, be made easier for engineers to maintain that strict line of integrity which all agree should be the ideal of our business men.

The methods detailed in the paper may or may not be copied here, but no one who has had experience of commercial life will deny that there are ways sometimes employed quite as reprehensible as those described, whereby purchasers are forced to pay more than they justly should, and the money is deflected by unfair methods into wrong directions. All such courses are rightly called "precarious expedients in engineering practice," and their elimination from present-day practice is quite as—in fact, far more—important as the advances in economy and efficiency which are sometimes spoken of as if they were the only marks of engineering progress.

It cannot be too strongly urged that it is in the truest interests of professional and commercial morality that every effort should be made to raise the moral standard of our modern life, and for this reason we regard the subject as one of a very suitable character for reading before an engineering Institution.

The Price of Rubber.

In our issue of the 11th instant, we dealt with the question of the price that manufacturers would probably have to pay for rubber during the next four or five years, and we have since then seen an article in the Financial and Commercial Supplement of the *Times*, which gives some interesting figures bearing on this subject. The writer of this article estimates the world's annual supply of crude rubber at about 68,000 tons, of which he attributes about 40,000 tons to the Amazon Valley. He then points out that the estimated annual consumption of rubber for the manufacture of motor tires is not less than 30,000 tons, and that rubber shoes absorb about 15,000 tons each year, so that these two trades alone require about two-thirds of the total production. We believe that the proportion is about correct, but we think that both the production and consumption are underestimated, as we should put them at about 80,000 tons and 50,000 tons respectively. The writer of the article then points out that, in tires and most other manufactured articles, a large percentage of the cost is represented by labour, power, canvas or other material, and standing charges of the factory, so that a rise in the price of rubber from 5s. to 10s., or 100 per cent., will only cause a rise in the price of the manufactured article of, perhaps, 30 per cent.; and that as most of these articles tend to the comfort of the human race, and have become practically indispensable, people will pay the extra price, rather than give up their motor cars, or give up their rubber shoes, or play golf with a ball that has not a rubber core. This is why, in spite of the enormous rise in the price of rubber, the consumption shows no sign of decreasing, but rather increases steadily. It is, we are afraid, the manufacturers of insulating materials, of which rubber is the base, who are more likely to find a falling-off in the demand, owing to the competition of other insulating materials, which will be materially assisted by the high price of raw rubber.

National Physical Laboratory.

At the annual inspection last week the chief items of interest were the new tank for experiments on models of ships, the gift of Mr. A. F. Yarrow, and the apparatus installed for the aeronautical investigations set on foot by the Government. Beyond the fact that these are, of course, equipped with electrical driving mechanism, they present little of direct interest to electrical engineers. In the electrical units department, under Mr. F. E. Smith, the Lorenz apparatus is approaching completion, and much valuable work has been done during the year in connection with the Weston standard cells. Mr. A. Campbell has made great progress in the evolution of new methods of measuring self and mutual inductance, effective resistance at high frequencies, and losses in telephone cables; and in the electrotechnics department Mr. C. C. Paterson has continued his researches in connection with photometry and the construction of a series of electrical metallic-filament sub-standards, run at different efficiencies, to bridge over the wide gap between the pentane lamp and the high-efficiency tungsten lamp; but the increasing volume of test work has occupied a great deal of the time of the staff. Mr. Rayner's research on insulating materials tested with high pressures, and Dr. Harker's electric furnace work, are also worthy of note. We shall return to the subject of the Report in a later issue.

The Workmen's Compensation Act.

It is day by day becoming more and more apparent that in these days of Socialistic ideals the inevitable result of the Compensation Act will be compulsory insurance against its manifold perils. At any rate, the employer who does not insure is running an extraordinary risk. Witness the most recent pronouncement of the House of Lords! It appears that a workman, suffering from an aneurism in so advanced a state of disease that it might have burst at any time, was tightening a nut with a spanner when the strain, quite ordinary in this quite ordinary work, ruptured the aneurism and he died. It has now been decided by a majority that this was an accident arising out of the employment of the workman. Consequently, the unfortunate employer had to pay £300 to the widow. Probably the employer was insured; possibly, even if he had not been insured, he might have been able to pay the money without much trouble; but what would have been the plight of a poor man who had not £300 in the world? The Court of Bankruptcy and no assets! An employer may be reasonably held liable for accidents which are the ordinary incidents of his trade, but how can he tell that the man whom he takes on for a job is the victim of some mortal complaint which may bring about his death at any moment? But the real gravity of the situation which is brought about by cases of this kind is the effect which it is likely to pro-

duce upon the infirm workman's chances of employment. Who would take a man into his service if he knew that at any moment he might die of heart disease or aneurism in circumstances which would render the employer liable? So long as the insurance companies continue to take these risks and to charge a uniform premium for all workmen, this point is not likely to be impressed on the employer; but there are signs of a change. Already one of the leading agents at Lloyd's has suggested that two rates shall be quoted to employers: one for cases where the men are all medically examined, and the weak ones rejected; and another rate, considerably higher, where no such examination takes place. If the great insurance companies adopt this precaution, what will be the inevitable result? Employers will institute a system of medical examination, and as a result the man who is least able to provide for himself will be cast loose upon an inhospitable world. If a member of the so-called Labour party is asked his views on this question, he will merely say: "The Government should provide old-age pensions at an earlier age," or, "pensions should be paid to those who are incapacitated by infirmity, as well as to those who are suffering from old age." That, we fear, will be the inevitable solution of this thorny question, unless some Government rises up which is strong enough to decree that a workman who is suffering from some physical infirmity shall be entitled partially to contract out of the Workmen's Compensation Act.

British Science.

At the annual meeting of the British Science Guild last week, Mr. Haldane, the President, declared that there were signs of progress on every hand; in education, in Imperial defence, in aerial navigation, scientific methods were being more and more generally adopted in this country, and if armed with science we should be able to hold our own. He said that happily we did not depend only on the Treasury for the financial support of science, and it is true that science would have miserable prospects if we did have to depend upon the niggardly doles grudgingly sanctioned by Governments composed of politicians, lawyers and faddists. Unfortunately, the rich men referred to by Mr. Haldane as supplying the deficiency are somewhat scarce: and in view of Mr. Lloyd-George's proposals to annex them also to the Treasury, they are not likely to multiply. The fact is that in spite of Mr. Haldane's unfailing optimism, science in this country is still starved by those who hold the purse-strings. There are, it is true, signs of a slow awakening, but we have a long way to go before we can agree that the importance of science has at last been appreciated by the nation.

Copper.

At last the visible supplies show a slight falling off, registering, according to Messrs. Merton's mid-monthly circular, 112,829 tons for March 15th, as against 113,455 for the end of February. The price has also eased slightly for the time being, though probably the bears have not yet finished with the market.

The details of supplies do not point to much activity in the market. They are all low except Chile shipments. The market appears to be waiting for a revival of trade, possible only after another period of temporary stagnation.

A review of the position published by the *Financier* for March 12th is, on the whole, inclined to anticipate a hardening market. It regards the combine as still going forward, but slowly, waiting for some fixed indication of the limitations to be placed by the Executive of the United States on similar companies. It points out that the world's output of copper is still capable of considerable expansion, and that low-grade mines can be worked successfully at present prices.

The total consumption for 1908, as given in the article, was 724,134 tons, or less than seven times the present visible supplies in Europe. Germany, as might be expected, came first with a consumption of 192,095 tons, North America took 185,270 and the United Kingdom 134,492 tons. A comparative list of the productions of the leading countries is also given, from which it appears that Peru is the only one with a marked advance, rising from 9,500 tons in 1907 to 17,000 in 1908. Of course, the mining interests in that country are largely under the control of the States market, so that this may be due to unloaded stock.

Past and Present: From £25 to £6,000 per Week.

When a man has devoted himself unflaggingly, and with a confidence that cannot be disturbed, to one great object during the more active and energetic years of his life, we may be pretty sure that in the fluctuations between adversity and prosperity which generally are met with in most businesses as they grow, he has been engaged accumulating experience as valuable as it a varied. Not only experience of a technical kind directly relating to the particular business, or that concerning commercial and organisation matters, but knowledge of men of all grades, which goes so far to ensure harmonious co-operation between all interests and departments, whether at the office or at the works.

It is impossible to ignore the supreme value of this quality for the making of business harmony, in connection with one of the most interesting functions that we have attended for a long time past. On Friday last at Hamilton House, where we have occasionally had to listen to electrical differences of opinion more or less vehemently expressed, there was a large gathering of gentlemen (seasoned with appropriate grace by a handful of ladies), who were all met together with one object about which they were not only completely united but enthusiastically so. They were assembled to tender their felicitations to one who in the old days "had a habit of taking his coat off" late in the afternoon when callers came no more, and who worked on into the night after most city offices were closed, while the foundations of a great business were in process of laying, or when Callender's Cable Co. was passing through its day of small things.

Those who remember what great movements forward have taken place in connection with the electrical industry in a quarter of a century, will not be surprised to learn that the wages paid by Callender's then averaged £25 per week. To-day they are fully £6,000 per week, and the annual balance sheet totals are fully a million sterling. A few thousands per annum was the modest turn-over then; now it is, in good times, a million per annum or over. These figures indicate generally the enormous growth of the affairs of the company and the manifold interests and questions that have needed attention. Mr. Tom Callender ("Mr. Tom" as he is sometimes affectionately called by those in the service of the company), as stated by the chairman, inherited a proud position, coming after a father whose memory is still preserved in love and honour by those who were associated with him, but there was on Friday last a united feeling that in doing honour to "Mr. Tom" they were giving well deserved recognition to one, who, more than anyone living, had been wisely directing the course of events during years of wonderful progress and development, taking advantage of every opportunity for the enterprising expansion of the business in every part of the world. The occasion was one for presenting Mr. Callender with an illuminated address (and his portrait, which has yet to be painted), and Mrs. Callender with an appropriate token, on the commemoration of their silver wedding.

The chairman, Sir Fortescue Flannery, could hardly have chosen his phrases more felicitously, but choice and sincere as they were, they were not more impressive than the few utterances of works engineers and others who wanted to say what they felt, but felt it too deeply to be able to express their sentiments in more than broken sentences. Mr. Callender, in his response, modestly alluded to the company having "done fairly well" on the whole, and acknowledged the very cordial co-operation of the directors and staff, both at the works and at the office, which had done so much to ensure success. He paid a high tribute to the signal services rendered by Mr. Theo. Petersen The wishes of those present that Mr. and Mrs. Callender may live to celebrate their golden wedding (in the active service of the company, shall we say?) will be heartily endorsed by large numbers of electrical men and others both at home and abroad.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Contractor or Manufacturer?

Referring to Mr. Cramb's letters of February 18th and March 7th, which appeared in the ELECTRICAL REVIEW, I must admit I was very surprised at their contents.

I observe that Mr. Cramb states that the letters are not intended as an argument for municipal trading. He has openly attacked the contractors as a whole. If this is not an argument for municipal trading, I wonder what is?

Perhaps Mr. Cramb knows that the staff of the publicity department and show room place orders practically where they will, with the result that some contractors get many orders and others get hardly any.

I know clever contractors and capable who are among the unfortunate; strange, is it not?

Mr. Cramb says that contractors persuade people to go in for expensive schemes so as to get a larger profit. Can Mr. Cramb mention one contractor in Croydon who has done this?

The electricity department seem to adopt a method of business without much interest from the Electricity Committee.

E. Foublster-Thomson.

Croydon, *March 14th*, 1910.

Protection and the Electrical Industry.

Can you find room for a newcomer into this discussion to refer to a special case?

First of all, I will deal with two generalities, and I will leave the personalities till the end.

It is often stated that "the consumer pays the tax," the tax in this connection being the import duty. I think it evident, however, that this is not necessarily correct, if the article is made in the country imposing the import duty. Suppose a duty of 10 per cent. is imposed, and allow for argument's sake that the price goes up 10 per cent., if the duty is raised to 1,000 per cent. who will say that the price will go up to the same extent, or that if importation is prohibited, the price will go up to infinity? I think this proves that there must be some point at which an increase in duty does not affect the price; and why should this point not be that of increasing the duty from nothing to something? It may be objected that my argument only applies when foreign competition is entirely shut out, and that if foreign goods do come in, the consumer pays the import duty. Take, however, the ordinary case of keen competition between home and foreign makers, such as exists at present in connection with electrical machinery. If for a certain contract the A Co. (British) would now quote £1,000, is it likely that on the imposition of an import duty of 10 per cent. they would quote £1,100 when they know that the B, C, D and E Companies all want the order, and would like to get it at about £1,000 (the "about" being the usual difference in tenders)? Again, if foreign makers had been getting orders at a profit, would they be more likely to put on the whole import duty, and run the risk of decreasing largely the number of orders, there being competition among themselves for the British orders, as well as with the home makers, or cut their prices, and thus bear part, or it might be the whole of the duty?

The other generality to which I wish to refer is that many Free Traders appear to think that the price of the foreign article entirely decides the home price. Take, however, the contractor or plumber, or similar person. Is his price for the work regulated by what the foreigner would charge? I trow not. It is regulated by what the other man would do it for. Of course, this is only another aspect of the point dealt with above. Now why should the same thing not apply to a manufacture in a works? It does; and this brings me to my special case, which, by the way, I have always found a severe fence for Free Traders.

I am a storage battery man, and do not suffer from any foreign competition at all in house lighting, central station and similar cells. Does this mean that I am making huge profits? No! We battery makers are cutting each other's throats, and agreeing to unfair conditions of contract, just as the machinery makers are, and in addition are agreeing to awful conditions of maintenance. Perhaps some Free Trader will explain the advantage there would be if foreign batteries could compete with English ones. I, myself, cannot doubt that the result would be that the weaker English makers would go out of business, and the stronger ones would share the total trade with the foreigners at about the same prices as at present prevail.

By the way, did I detect a chastened tone in the remark in your leader a few weeks ago on the subject of the Census of Production that this showed that *only* 14 per cent. of the total consumption of electrical machinery comes from abroad? The gods on high Olympus be thanked that "only" 14 per cent. of the consumption of batteries does not come from other countries.

I could enlarge on the application of the battery example, but have just remembered (rather late, I am afraid) a hint you gave the other day *re* the length of letters.

Protected Battery Maker.

P.S.—I find I have forgotten the personalities. What a pity! I intended to use the words "insane," "preposterous," "idiotic," "outrageous," "ill-bred," "rude," &c., and I wished to call one "Free Trader" "thou lump of foul deformity," and say to another "Oh! be thou damned, inexecrable dog." It is too late now, and I must be content to be out of the fashion.

Patching Poles.

It is well known that poles employed for overhead mains commence to decay just at the ground level, even though they have been subjected to some preserving process, such as creosoting or kyanising.

One hears of various devices to prevent this early decay, and, amongst them, that of forming a sleeve of armoured concrete round the base of the pole about 18 in. above and below the ground level. The writer would be glad to hear the experiences of your readers as to the effectiveness of this protection, and also to know if they have found such a sleeve reliable when used to strengthen poles which already show signs of decay. In the latter case the decayed part would have to be cut away all round the heart that remained.

The writer is afraid lest the decay should still go on under this sleeve, when it would be more dangerous as it would be out of sight. Supposing that this is the case, the writer would be very much indebted to any reader who could tell him of some proved device for strengthening poles which have commenced to decay.

O. H. W.

[Many poles have been "restored" in America on the lines mentioned. See ELECTRICAL REVIEW, Sept. 10th, 1909, p. 433.—EDS. E.R.]

Publicity Literature.

I note that my letter which appeared in your issue of March 11th, under heading "We Sell Electricity and Publicity Literature," has caused the Joint Publicity Committee's advertising agency to write stating that I am in error as regards prices. My only error is that the figures I mentioned are a trifle high, for I have an actual quotation before me from an advertising agency, which therefore must include two profits—viz., the printer's and the agency's. The actual prices quoted work out as follows:—For a similar poster to that of the Joint Publicity Committee, 5s. 3d. for 50, as against 25s.; showcards, 3s. 2d. for 50, as against 30s.; folded circulars without illustrations, 15s. per 1,000, as against 20s. For 21s. per 1,000 I can obtain an attractive special folder, with coloured illustrations. I have not seen the actual poster which the Joint Publicity Committee offer, but I have read the description and have seen a reduced *facsimile*. The only "exceptional" position that the Joint Publicity Committee seem to be in, is that of apparently being a co-operative movement, without charging co-operative prices.

For from the prices I have mentioned it is evident that there should be a considerable margin between the figure at which they could get the work done and the one they now charge for the printed matter.

However, this matter of prices is but a minor commercial consideration, though indicative of unsound management; rather the point I wished to emphasise was that, to all appearances, the Joint Publicity Committee had no concrete, systematic and consistent scheme in view, an all-essential feature of successful publicity work.

Central Station Man.

Emigration.

With reference to the short article on the subject of "Emigration" which appeared in your issue of December 31st, I enclose a copy of a letter sent in reply to inquiries from your readers for further information. This may be of use to others who are interested in the subject.

I may add that an experienced Canadian engineer who saw the article has informed me that he is able to endorse the same as representing an accurate general summary of conditions in Canada at the present time.

Ernest T. Williams.

Hong Kong, *February 22nd*, 1910.

"With reference to your letter asking me for certain information relative to the subject of emigration to Canada, I think you will do well to communicate with the emigration department of the Canadian Government in London. This office specialises in supplying information to possible emigrants and replying to the numerous questions that arise when the subject is under consideration. The Canadian Pacific Railway Co., the Allan Line, and the Salvation Army, which has done splendid work for Canadian emigrants, might also be written to.

"You will understand that it is almost impossible for me to estimate the chances of success of any particular individual with whom I am not personally acquainted, for so much depends on character; but I was repeatedly assured that, if a man is really determined to get on, has fair ability, and is not stopped by trifles, his opportunities are very numerous.

"One ought to have enough money to keep him going for a few days after arrival, and a little reserve in addition is desirable; but a man should take the first suitable job he can get, so as to be looking round and accumulating a further reserve.

"Go out at the time of the year when things are getting busy; your trans-Atlantic ticket will take you to Montreal, and you may find it desirable to work your way West to Toronto, Winnipeg or Vancouver later."

Institution of Mining Electrical Engineers.

Referring to the leading article in your current issue, I take the liberty of making a few remarks on the same; whilst agreeing with you on some points, I must differ on others.

Respecting the status question, this has not been absolutely ignored. Further, your information *re* membership—that very few engineers-in-charge have joined the Institution, is incorrect. I think, if the membership is analysed, it will be found that the biggest percentage of members consists of mining electricians and working mining engineers or enginewrights.

The question of status is fully dealt with in our articles of association, and you will no doubt agree with me that before we can hope for any reform we must be a recognised body. Our articles of association provide for a class of diploma members, and these will in the future be the backbone of the Institution, but we must creep first, and before we can think of diploma-ship we must become incorporated. The whole crux of the matter lies in the few following words:—

Our articles were sent to the Board of Trade for registration last October, and so far we cannot obtain any definite or satisfactory explanation as to the delay in registration.

Are we to assume that it is on account of opposition from other institutions? What other cause can there be?

If it is on account of other institutions' opposition, why have we not had official notice?

Is it on account of the abnormal amount of work passing through the Board of Trade office, or red tapeism?

Is it slackness on the part of the general secretaries of the Institution in not pressing the matter of registration?

The question of mode of government of the Institution crops up—as to whether it was advisable to transfer the main duties of secretary from the late secretary, who is a working mining electrician, to professional secretaries, as in the first case, there was a direct interest in the future of the Institution; but again there arises the question of the work involved in addition to his own work.

To sum up the whole question, therefore, I am sure the objects originally set forth will be carried out as soon as we are recognised as a registered Institution, and it will be to the interest of all the members to take steps to find out the reason of delay on the part of the Board of Trade in our registration and acceptance of articles of association, more especially as much valuable evidence suitable for the present inquiry is being withheld by the working members, owing to their present non-official position.

One of the Council Members.

The Electrical Industry and a New Organisation.

With reference to the letter appearing in this week's Electrical Review referring to the Electrical League, will you permit me to say that I must decline to answer anonymous communications, but that if the writer of the letter will give his name and address, I shall be happy to give him the information which the letter alleges he is desirous of having.

R. Borlase Matthews, Wh. Ex., A.M.I.C.E.

London, W.C., *March 19th*, 1910.

Municipal Appointment.

In view of the advertisement recently appearing in the Review for a switchboard attendant and junior engineer in charge, the following cutting from the *Daily Chronicle* of the 16th may be of interest to the 200 odd applicants for the vacancy.

Comment is superfluous, but I think in justice to your readers you should refuse any future advertisements from the same source, and so save candidates unnecessary expense.

One of the Short List.

[The cutting described the appointment of the son of Councillor Oake, chairman of the Bermondsey Electric Lighting Committee, to the post of switchboard attendant at the Council's generating station, after a noisy discussion. Station engineers will not be petrified with astonishment thereby.—Eds. E.R.]

A New Zealand Project.—A scheme, involving an expenditure of £215,000 for an enlarged electric supply scheme, has been adopted by the Auckland City Council. The scheme is due to Mr. A. Wyllie, the city electrical engineer, who reports that the present combined destructor and electricity plant is inadequate for the needs of the city, and cannot be efficiently extended. A new site has been leased from the Auckland Harbour Board, and it is proposed to erect a steel-frame power house on it. The estimates show £65,300 for buildings and sites of generating and sub-stations; £26,100 for boiler house plant, including six boilers, economiser, steel chimney, feed pumps, conveyors, cranes, &c.; £58,800 for the engine room equipment, including four D.C. generators (3,000 KW.) and two A.C. generators (1,000 KW.), condensing plant, balancers, boosters, switchgear, crane, &c.; £10,000 for the equipment of two sub-stations with transformers and converters; and £45,000 for new feeders, services, meters, &c. Mr. Wyllie points out that the estimates cover capital expenditure during the next five years; the initial area of supply will have a radius of about 1¾ miles from the power house, for which the first equipment of two 500-KW. and two 1,000-KW. D.C. generators will provide; in order to supply further limits and large power consumers two 6,000-volt three-phase turbo-alternators are proposed. The station building will be on a wharf and accessible to sea-borne coal, and it is estimated that the undertaking will be profitable from the second year.

D

THE ONTARIO GOVERNMENT TRANSMISSION SYSTEM.

A recent issue of the *Canadian Electrical News* contains an article by P. W. Sothman on the Ontario Government transmission system, which is under construction at the present time.

The Government, through its agent, the Hydro-Electric Power Commission, agrees to supply energy to the boundary of each municipality (the supply pressure being 13,200 volts), and the latter does its own distributing.

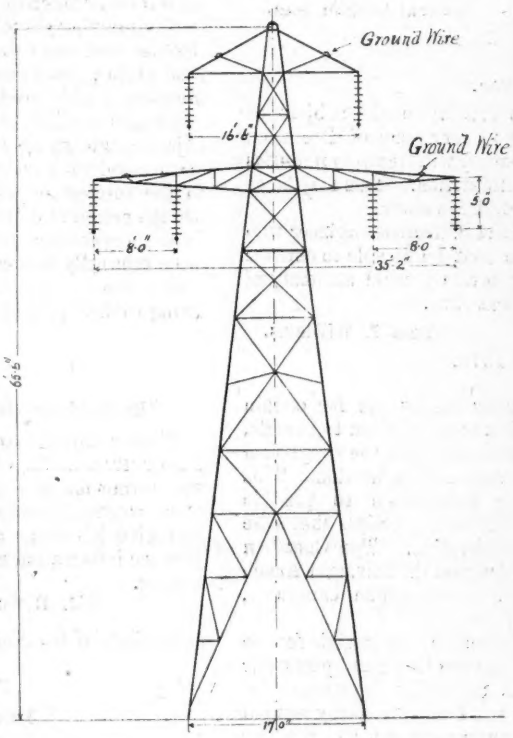
It will be remembered that the Ontario Power Co. has contracted to supply energy—up to 60,000 h.p.—to the Commission from its Niagara plant, which has a capacity now of 80,000 h.p., and will, when complete, be able to deal with 220,000 h.p. Near this power plant the Commission is erecting a 60,000-h.p. transforming station in order to step up the 12,000-volt supply of the Ontario Co. to 110,000 volts for transmission purposes to the towns of south-western Ontario. About 30,000 to 40,000 h.p. has been contracted for up to the present in this area, a map of which, with the transmission routes, was shown in our issue of September 24th, 1909.

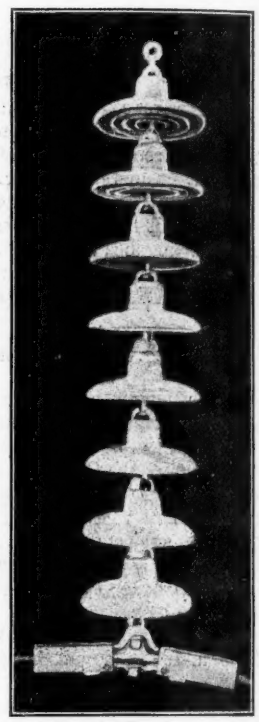
Some 290 miles of line is being installed, a portion of which is in duplicate, and consists of 4/0 B. & S. and 3/0 B. & S. gauge aluminium wires, hung from suspension-type insulators on metal towers.

The towers, 3,000 in number, average 10 to the mile, giving an average span of 525 ft. The particular type selected was designed by the Commission, and on test withstood a horizontal pull of 20,000 lb. without injury, bending over, however, with a 20,950-lb. strain.

A competitive tower tested in the same manner collapsed under a 14,650-lb. pull.

The towers are each 65 ft. 6 in. high over all, and carry upper and lower arms, 16 ft. 10 in. and 35 ft. 2 in. long respectively. The eight part suspension insulators are 5 ft. 2 in. long × 11 in. diameter, and when erected the cables in each circuit are 9 ft. apart.





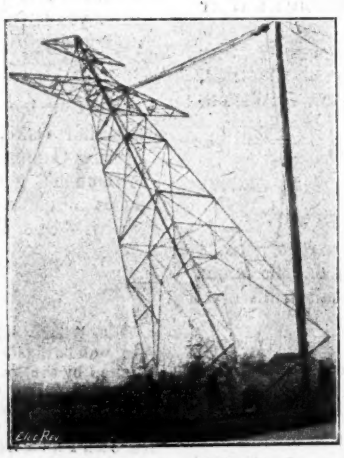
Ontario Government Transmission Tower and Suspension Insulator.

The tower bases measure 17 ft. sq. and their construction allows of cultivation underneath, the headroom being about 20 ft.; the feet have 22 in. × 34 in. iron grates bolted on to them and rest on 6 in. of stones at a depth of 7 ft. 6 in. in the ground.

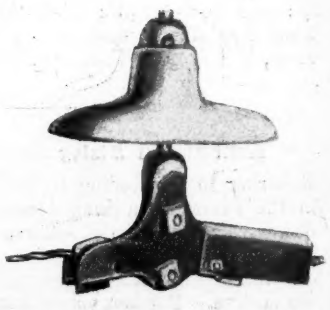
No concrete is used except in marsh land and on hill-sides. Special towers are required at the Welland Canal crossing, where the conductors have to be 150 ft. above high water.

The standard tower weighs 3,995 lb. and is shipped in 22 ft. sections; it is assembled on its side close to the footing excavations and erected by block and tackle with the aid of a team of horses, the erection requiring only 10 or 12 minutes.

The selection of the suspension type of insulator was the result of lengthy tests under wet and dry conditions, with pressures up to 400,000 volts. Two engineers spent three months on this work before a final choice was made. Four 5/16 galvanised-steel ground wires run the whole length of transmission line as a protection against lightning, two being attached to the upper and two to the lower cross-arm. Owing to the possibility of a discharge from the insulator to the wire at the clamping point, the clamps are provided with protecting hoods, which bear the brunt of the discharge and so protect the cable.



Method of Erecting Tower.



Insulator Clamp, with Protecting Hood on R.H.; other one Removed.

Electric Drive in U.S. Cotton Mills.

—The *Financial News* quotes a report showing that 26 per cent. of the 312 cotton mills in North Carolina are now using electricity only for driving purposes; 35 per cent. of the mills use electricity either entirely or in part, and the indications are that this percentage will gradually increase until practically every mill which is accessible to electric power supply will be electrically driven.

LEGAL.

Damage to a Feeder Pillar.

At Newcastle-on-Tyne County Court on the 18th inst., before Judge Greenwell, an action was heard in which the Mayor and Burgesses of Tynemouth claimed damages from Mr. John G. Ormond, of Percy Gardens, Tynemouth, in respect to an accident at Tynemouth on October 30th, when an electric feeder pillar belonging to the plaintiffs was knocked down by the defendant's motor-car. The defendant pleaded that the damage was due to an unavoidable accident, for which he could not be held responsible. Mr. Edward Shortt, M.P., was for the plaintiffs, and Mr. E. Meynell was for the defendant.

Mr. Shortt said the amount of damage, if any, had been agreed upon, and the only question was one of liability. The pillar was situated at the north-east corner of Front Street, Tynemouth. About 8.30 a.m. on October 30th last the defendant left the yard of the Salutation Inn, driving a motor-car. He was proceeding at about four miles an hour, and had his hand off the steering wheel, when the car ran into the feeder pillar and knocked it down. Mr. Ormond had said that the car skidded on the front wheels because of ice that was on the road. But there was evidence that, although there was frost, it was not enough to have caused the car to skid.

Henry Albert Buck, letter carrier, said Mr. Ormond had his head down, and was apparently putting on his gloves. Witness saw the accident; there was no sign of a skid.

A Gunner in the Royal Artillery said Mr. Ormond's hands would be about 6 or 7 in. above the wheel.

A Constable said that, after the accident, Mr. Ormond said something had gone wrong with the steering gear, and, before he could pull up, the car dashed into the pillar.

Other evidence was given.

Mr. Ormond said that on the morning in question he had no gloves on. At the corner of the street the car skidded on account of the state of the road. There were sheets of ice more or less all over the road. His right hand was never off the wheel.

His Honour said no explanation of the accident had been given that could carry conviction to any reasonable mind. He gave judgment for the plaintiffs.

P. & O.S.N. Co. *v.* T.C. & M. Co.

In the Admiralty Division Mr. Justice Bargrave Deane, sitting with Trinity Masters, disposed of an action brought by the Peninsular and Oriental Steam Navigation Co. to recover damages arising out of a collision between their steamship *Nile* and the cable steamship *Telconia*, belonging to the Telegraph Construction and Maintenance Co., Ltd. The casualty took place in Sea Reach, River Thames, on the night of December 24th last. The *Nile*, a vessel of 6,694 tons gross register, was lying at anchor, having brought up on account of fog. She was in course of a voyage from London to Calcutta laden with general cargo and carrying 64 passengers. The *Telconia*, a much smaller boat, her gross tonnage being 1,013 tons, was bound up river to London. The defendants admitted that the *Telconia* was negligently navigated, but pleaded that their servants were not guilty, as the vessel was in charge of a compulsory pilot, who, they said, was alone to blame. They therefore claimed that they were exempt from liability.

Mr. F. Laing, K.C., and Mr. R. H. Ballock appeared for the plaintiffs; and Mr. B. Aspinall, K.C., and Mr. A. D. Bateson for the defendants.

His Lordship, giving judgment, said it was not suggested that anything on board the *Nile* led to the collision, and the only question was who on board the other ship was responsible—her pilot or the crew. There appeared to have been some defect in the steering on the *Telconia*, and the master sent the third officer to the wheel-house to superintend the steering. The third officer seemed to have adopted the strong measure of turning the quarter-master, who was at the wheel, away, and he himself took the helm. It was said that this occurred some time before the collision, and had nothing to do with it. His Lordship, however, could not take that view. For some reason this handy little vessel, in a distance of half to a quarter of a mile, was unable to clear the bows of the *Nile*. What was the explanation? In his Lordship's opinion there must have been asteadying back after the starboarding, and he thought there was a mistake as to the time when the difficulty occurred at the helm. "Too many cooks spoil the broth" and so, if there were too many people interfering with the steering at a critical moment, one must anticipate trouble. The collision was due to the quarter-master failing in his duty at the critical time when the lights of the *Nile* came into view, in that he imoroperly steadied back again, after starboarding. There was negligence therefore on the part of a servant of the defendants, and consequently the plea of compulsory pilotage failed.—Judgment was accordingly entered for the plaintiffs with costs, the damages to be assessed.

PARLIAMENTARY.

Bishops Stortford Gas and Electricity Bill.—This Bill was before Lord Hylton's Select Committee of the House of Lords several days last week, and on Thursday the preamble was passed. The Bill provided for the vesting of the undertakings of the Bishops Stortford, the Harlow and the Epping Gas Companies in a new company with a capital of £240,000, of which £164,508 will be known as the original capital and will be substituted for the present share capital, whilst £135,435 will be new capital. It further provides for the vesting of the Ongar, Newport and Much Hadham Gas Companies' undertakings in the new company, and power is further taken to purchase the undertaking of the Dunmow Gas Co. The only opposition came from the Bishops Stortford local authority with reference to the power asked for to supply that district with electricity, but the parties came to an agreement on the basis of the local authority having the power given it of acquiring the electrical undertaking at the expiration of 21 years from the commencement of the works, and if the right is not then exercised it will have the right of purchase at every succeeding seven years.

Farnham Gas and Electricity Bill.—Lord Hylton's Select Committee on Thursday passed the preamble of the above Bill, which dissolves the Farnham Gas Co. and reincorporates it under the name of the Farnham Gas and Electricity Co. Power is also taken to construct a generating station, and to supply electricity. The capital of the company will be £60,000, of which £30,800 will be new. The company asks for permission to appropriate certain lands in the Urban District of Farnham, and to erect a generating station. Further, the Bill repeals the Farnham Electric Lighting Order of 1905.

National Telephone Co.—Mr. Bottomley asked the Postmaster-General whether, when taking over the undertaking of the National Telephone Co., it was proposed to require particulars from the company of all unclaimed deposits in its possession, with a view of seeing that they were returned to their rightful owners.—The Postmaster-General, in reply, states that this point will not be overlooked.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Motor-Car Charging Set.

Amongst other electrical accessories for motor-cars, Messrs. Ward & Goldstone, of Springfield Lane, Salford, are introducing the neat little charging set illustrated below. This consists of a "Facile" dynamo, measuring 12 in. × 7 in. over all, and a current controller, and is intended for use in conjunction with accumulators for ignition and lighting purposes. The dynamo, which is fitted with ball bearings, takes very little power, and is belt driven from the half-time shaft. When the engine is stopped, the circuit between the dynamo and cells is broken; when the engine starts running, as soon as the normal speed is attained the circuit is

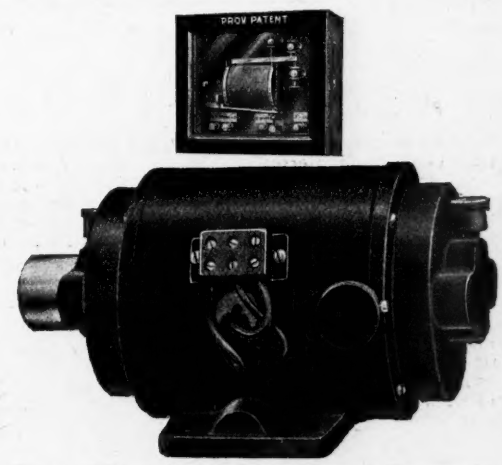


Fig. 1.—"Facile" Dynamo and Current Controller.

closed and charging commences, and if an abnormal speed is attained, the controller automatically inserts resistance, preventing excess of charging current. The apparatus, which we have seen at work, is extremely simple, and weighs in all only 21 lb. Besides keeping the cells up to the mark, it provides current for lighting the car inside and out, an immense convenience. Standard outputs are 8 amps. at 8 volts, or 6 amps. at 10 or 12 volts. Full particulars of the set, and of electric head lamps, batteries, &c., are given in the firm's 1910 supplement.

Variable-Speed S.P. Motor.

A single-phase commutator motor has been placed on the market by Mr. H. C. E. Jacoby, 26, Norfolk Avenue, N., which, while having a shunt speed characteristic, yet has a wide and efficient range of speed variation, giving the same facilities of speed regulation on single-phase A.C. circuits as can be obtained with D.C. motors.

The accompanying efficiency curves (fig. 2), which have been plotted from careful tests with a 15-H.P. motor, show a good efficiency at all loads such as is generally obtained by the commercial D.C. motor. Curves for three different speeds are shown, viz., 680, 500 and 340 R.P.M. The motor may be run at any speed between zero and a speed a little above synchronism.

It will be seen that the efficiencies on the lower speeds are actually higher than on the higher speeds up to nearly three-quarters full load, after which the curves cross one another in an interesting manner.

The output of the motor at the lower speeds is, of course, less in horse-power than at the higher speeds. The horse-power obtainable with a given temperature rise is nearly proportional to the speed. The curves showing the total losses in the motor, which are plotted for the speeds of 680 R.P.M. and 340 R.P.M., are worthy of notice. At the higher speed the total losses slightly diminish as the load is increased, after which, up to about half-load, the decreasing hysteretic loss is almost exactly balanced by the increasing copper losses, so that the losses are constant between one-fifth and half-load.

At the lower speed of 340 revs. per minute, the loss curve turns upwards all the time, as, of course, for a given H.P. on the lower speed, the copper loss is greater at the higher speed.

The motor is of the commutator type, and has a special winding in the rotor which gives perfect commutation on all loads, and at all speeds. No starting device, other than a single-pole switch, is required, either for starting or for speed regulation.

The highest efficiency is generally obtained at about ·8 synchronism, but this figure varies with the size of the motor. The motor will stand up against twice full-load torque, calculated at the above speed, with a current consumption not exceeding 1·5 times full-load running current.

The power factor of these motors is generally higher in the smaller sizes, and may be as high as ·95 on full load. The power factor of the motor for which the efficiency curves are given is ·84, with 12·7-kw. input, and ·78 with 8·5-kw. input.

The speed regulation is obtained by means of a centrifugal governor, in appearance like a cap at the end of the bearing. The governor is connected by a lever and chain to the brush rocker, which is automatically moved so as to bring the brushes into a

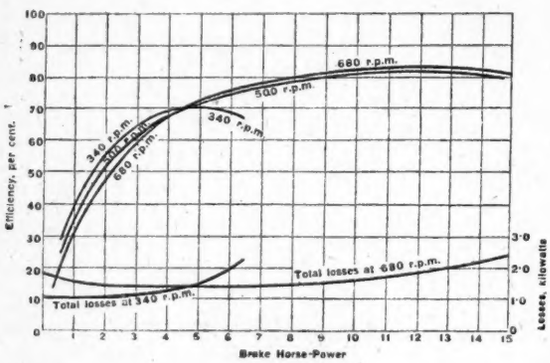


Fig. 2.—Efficiency Curves of S.-P. Motor.

position which balances torque and speed. The variation between full and no load does not exceed 3 per cent. This arrangement has the advantage that on the lightest loads, the motor is much more efficient than would be the case if the brushes were fixed. The regulation in speed is obtained by adjusting the tension of the governor spring, which is placed in an accessible position. Distance control can be arranged by means of a solenoid.

Cut-Out Boards.

The General Electric Co., of 71, Queen Victoria St., E.C., has recently introduced an improved type of 250-volt ironclad double-pole cut-out board, with hinged lid. Ample clearances are allowed between live parts and case, and the boards are suitable for the highest class of screwed tube work, complying with the L.C.C. and fire

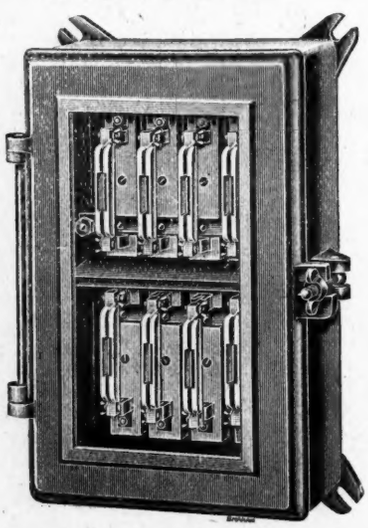


Fig. 3.—Ironclad Cut-out Board.

insurance requirements. Channel fuses, each mounted separately on china bases or on two slabs of enamelled slate (one for each pole), are supplied as required; and the standard cases are all drilled for the conduit, one hole being allowed for each branch circuit and one for the two mains. The boards are made for up to ten 5-ampere or 10-ampere ways.

Acton Electricity Supply.—The electrical engineer is to prepare a complete scheme for giving an extended supply of electricity to the large factories in the neighbourhood of Acton Vale, together with an approximate estimate of the total cost of the scheme, for consideration by the Council.

OVERHEAD WIRES AND THE LAW.

[FROM A LEGAL CONTRIBUTOR.]

Questions have often been addressed to the Editors of the Electrical Review with regard to the rights and liabilities of those who transmit electricity for power purposes by means of overhead wires. With a view to providing answers to these questions, the following summary of the law may be found useful:—

The subject may be conveniently dealt with under the following headings:—(1) Preliminary; (2) Effect of Sec. 14 of the Electric Lighting Act, 1882; (3) Suspension of Wires by Persons having no Statutory Authority; (4) Power of Local Authority to Prevent the Suspension of Wires; (5) The Public Health Amendment Act, 1890 (6) London Overhead Wires; (7) Summary of the Law.

1. *Preliminary.* *Prima facie* every landowner has the right to suspend wires over his land. The common law of England places him under no restrictions, he can do what he likes with his own. The owner of the soil is master of the situation. The principle applies even to the soil of the highway. As a general rule, the highway is vested in the landowners on either side, *usque ad medium filum viæ*. The public may have certain rights of passing and repassing along it; the highway authority may have the duty of repairing it cast upon them; but so long as the public right-of-way is not interfered with, the owner of the soil can permit wires to be suspended as and where he chooses.

But Parliament has decreed that this very extensive power shall be curbed. This is for the protection of the public.

The question whether overhead cables transmitting powerful currents are sanctioned by the law can be answered by reference to certain sections of the Electric Lighting Acts, and to that portion of the common law which relates to highways.

By Sec. 14 of the Electric Lighting Act, 1882, it is provided that undertakers shall not be authorised to place any electric line above ground, along, over or across any street, without the express consent of the local authority.

The term "street" includes any square, court or alley, highway, lane, road, thoroughfare or public passage or place within the area in which the undertakers are authorised to supply electricity.

2. *Effect of Section* 14 *of the Electric Lighting Act*, 1882.—This section confers upon local authorities an absolute discretion to allow or prevent the use of overhead electric cables in what may be generally termed public places, but it will be observed that the section confers no power upon the local authority to interfere with wires put up by persons who are not working under a licence, order or special Act. The importance of this will be dealt with later.

Not content with restricting the use of overhead cables in streets and places *ejusdem generis*, the Legislature, by an Act which is now incorporated with every provisional order and special Act, expressly extends the power of the local authorities.

By Sec. 10 of the schedule to the Electric Lighting (Clauses) Act, 1889, it is provided that, subject to the provisions of the special order and the principal Act, the undertakers may supply energy within the area of supply for all public and private purposes, as defined by the said Act, provided as follows:—

(*a*) Undertakers shall not, without the express consent of the Board of Trade, and where the local authority are not themselves the undertakers, of the local authority also, *place any electric line above ground* except within premises in the sole occupation or control of the undertakers, and except so much of any service line as is necessarily so placed for the purposes of supply.

The short effect of this section is to make the consent of the Board of Trade and the local authority a condition precedent to the adoption of the overhead system by undertakers who are working in pursuance of statutory powers.

It should be mentioned that in addition to the powers conferred by Sec. 14 of the Electric Lighting Act, 1882, some corporations have had more stringent powers conferred upon them by their private Acts. See, for instance, the Southport Corporation Act, 1900, Sec. 54; the Manchester Corporation Act, 1888, Sec. 47; the Darwen Corporation Act, 1899, Sec. 94; and the Blackburn Corporation Act, 1901, Sec. 122. In each of these cases the corporation have power to withhold their consent to the suspension of wires; but in some instances the consent can only be withheld if it is shown that the electric line is a menace to the public safety.

3. *Suspension of Wires by Persons having no Statutory Authority.*—In order to bring under the control of the Board of Trade lines and works for supplying electricity, which were then, and now are, in existence, without licence, provisional order, or special Act, the Electric Lighting Act, 1888, Sec. 4, provides that where in any case any electric line or other work may have been laid down in, or erected in, over, along, across, or under any street for the purpose of supplying electricity, or may have been laid down or erected *in any other position* for such purpose in such a manner as not to be entirely enclosed within any building or buildings, or where any electric line or work so laid down or erected may be used for such purpose otherwise than under, and subject to the provisions of a licence, order, or special Act, the Board of Trade may require that such electric line or work shall be continued and used only in accordance with conditions and regulations for the protection of the public safety.

Sub-sec. (2) provides for the protection of the Postmaster-General. Sub-sec. (3) inflicts certain penalties upon persons who omit to fulfil the requirements of a notice under Sub-sec. (1), and confers upon a Court of Summary Jurisdiction power to order the

removal of any electric line or work specified in such notice by such person, and upon such terms as they may think fit.

From the above enactments it will be seen that whenever a company supplies electricity under statutory authority, the consent of the local authority must be first obtained before any cables can be suspended. In the one case, where a company supplies electricity on their own account, they are independent of the local authority, and are subject only to the rules and regulations published by the Board of Trade. Regulations for aerial lines have been issued by the Board of Trade. It is sometimes said that they are too stringent, but their very existence is a recognition of the fact that where suitable precautions are taken electricity may be safely transmitted by this means.

4. *Power of Local Authority to prevent Suspension of Wires.*—Having considered the material parts of the Electric Lighting Acts, it will now be convenient to inquire whether the local authority have any other right to prevent the erection of poles in, and the suspension of cables across, the highway. They may seek to exercise this power with a view to indirectly preventing the supply of electricity within their area. If poles which obstruct carriages, horses, or foot passengers, are placed in the highway with the object of keeping them there permanently, the persons who put them there are liable to indictment for nuisance. (Rex *v.* United Kingdom Electric Telegraph Co., 2 B. and S., 647.) It is hardly necessary, however, to consider further whether the erection of poles can be prevented, as by arrangement with adjoining landowners, the necessary support can be given to the cable without infringing any public right.

The principal duty of the highway authority is to keep the roadway clear and free from any source of danger to liege subjects passing along it. If, therefore, a cable is made strong enough, and is placed far out of reach of the traffic, it is submitted that no objection can be urged on the ground of nuisance or danger. The point has not been decided in respect of cables carrying heavy currents, but if a telephone wire is suspended above the road at a sufficient elevation there is warrant for saying that the controllers of the highway have no right to interfere with it. Thus, in the case of the Wandsworth Board of Works *v.* United Telephone Co., it was held that the Metropolis Management Act, 1855, Sec. 96, which may be taken as a type of the statutes which at the present time confer rights upon highway authorities, does not confer upon a vestry or a Board of Works such a property in the streets situate within their district, as to entitle them to maintain an action for an injunction against the erection of a telephone wire across a street, that wire being erected at a great height and causing no appreciable danger to the public or to the traffic in the street.

It is submitted that this decision would be followed by any Court which may ever have to determine whether an insulated cable above a street is a public nuisance. Such an erection is far less dangerous than the trolley wires in common use. Thus it may be easily insulated; it may be supported by a steel wire; it crosses the highway and does not run along it. If an accident does happen there is little risk. Further, a cable of this kind is not subjected to the incessant vibration and friction which tend to shorten the life of a trolley wire.

In Finchley Electric Light Co. *v.* Finchley Urban District Council, 1902, 1 Ch. 866, the defendant Council had obtained, but had not put into operation a provisional order empowering them to supply electricity within their area. The plaintiff company began to furnish a supply on their own account, and in order to reach their consumers they suspended cables over certain highways, poles being placed on either side of the road with the consent of thhe frontagers. The district council contended that they were entitled to remove these wires; but the Court of Appeal held that they were not, inasmuch as the Council only owned the street and could not therefore prevent the suspension of wires above it and out of reach of the traffic. In the case of Fareham Local Board *v.* Smith (1891, 7 T.L.R. 433), the Local Board contracted with the company to light a town. No license, provisional order, or special Act had been obtained. The defendant was owner in fee of certain lands adjoining a public highway, and he alleged (1) that the poles and wires placed by the company in the highway interfered with certain building operations on his land; (2) that he was entitled to remove the poles as owner of the subsoil of half the highway. On application made, the late Lord Justice Chitty granted an injunction to restrain him from so interfering for the following reasons:—

"The highway in question is a street within the meaning of Sec. 149 of the Public Health Act, 1875, and it is vested in the Local Board, who are entitled to more than the surface, and who further have an area of user necessary for lighting their district. The Local Board have a proprietary right in the zone above the surface, or, at any rate, have a possession of so much above and so much below as falls within the objects of the Act. The electric lighting company has merely acted in pursuance of its contract, and is therefore not liable." It is but a short step from this to say that a company like the Finchley Electric Light Co., Ltd., who supply a much-needed want in their district, are performing a public duty, in pursuance of which they may, to a certain extent, infringe the private rights of owners adjoining the highway.

5. *The Public Health Acts Amendment Act*, 1890.—We have next to consider Part II of the Public Health Acts Amendment Act, 1890. This Act does not apply to London. It is an adoptive Act, that is to say, it does not come into force in any district unless it is formally adopted by the urban district council. It empowers that body to make by-laws for the prevention of danger or obstruction to the public from posts, wires, tubes or any other apparatus stretched or placed above, over, along or across any street, for the purpose of any telegraph, or any other purpose. The words "other purpose" must be taken to include electric lighting and the transmission of power by electricity. By-laws so made must be confirmed by the Board of Trade. Rural authorities may be vested by the Local Government Board with urban powers for the purpose of the Act. The Act does not extend to any works of any undertakers within the meaning of the Electric Lighting Acts, 1882 to 1888, and it is all-important to notice that it does not *prohibit* the use of overhead wires and cables; it merely empowers a local authority to make by-laws for the protection of the public. Provided those by-laws are complied with, the local authority would have no power to prevent the suspension of cables.

6. *London Overhead Wires.*—One word as to the London Overhead Wires Act, 1891. That statute gives power to the London County Council to make by-laws, and from time to time to vary the same, with respect to—

(*a*) The identification of overhead wires by registration or otherwise;

(*b*) The regulation of wires;

(*c*) The strength of the materials to be employed in placing, maintaining, and supporting wires; and

(*d*) The removal of wires erected or placed otherwise than in accordance with such by-laws and of disused wires.

These by-laws are enforced and administered by the local authorities. If it is right that additional precautions should be taken with regard to the erecting of overhead wires in the metropolis, it does not follow that the same rules should in effect be made applicable in rural districts.

7. *Summary of the Law.*—What, then, is the accurate summary of the law relating to overhead wires? If a company possessed of Parliamentary powers to supply electricity attempts to transmit by the simplest and most economical means, their zeal may be checked by local authority, whether that local authority are themselves the owners of a provisional order or not. If, on the other hand, a company outside London supply electricity without official or Parliamentary sanction, they may use aerial lines constructed according to the Board of Trade regulations. In the writer's view, so long as such lines do not interfere with the traffic along the highway, and so long as the posts supporting them are erected on the land of adjoining owners, with the sanction of those owners, no local authority has any power to interfere.

SAFETY IN HANDLING HIGH-TENSION GEAR.

An increasing amount of the apparatus which the switchboard attendant in a central station is called upon to handle is subjected to very high pressures, either direct or alternating, and a great deal has been done to render the attendant safe in dealing with such high voltages when normal switching operations are in progress. It is, however, a well-established fact that a designer cannot foresee every contingency, and when a breakdown occurs even in the best designed switchboards occasions arise when, unless the attendant exercises very great care, he may be subjected to a shock which may prove fatal. Owing to the fact that it is in most cases impossible for an attendant to obtain any automatic warning that the apparatus is dangerous until the damage is actually done, it is obvious not only that every possible means should be taken to indicate either by the nature of the design of the switchboard or by danger indications painted or otherwise marked on the various appliances that danger is present, but also that the attendant himself should take precautions to guard himself against the possibility of contact.

Dealing first of all with the question of design and danger indications, which is the concern of the manufacturer of the plant and of the supply authority using it, one great point to observe is that the switchboard should be so constructed that every connection can be easily followed. In this way the attendant before touching any part of the apparatus to connect or disconnect it or for the purpose of cleaning will be able to see whether there is any possibility of that part being charged with electricity. Such a provision should, moreover, be reinforced by distinctive colourings on the cables. For example, high-tension cables should be painted, say, a bright red, especially at parts where it is thought there may be liability of danger. This is sometimes difficult to arrange—say, on a three-phase installation where different colours represent different phases; but it should be possible to make provision for a warning signal of some description which no attendant could neglect without gross carelessness. At the very least, care should be taken to see that there is nothing actually misleading about a switchboard; for example, high-tension apparatus and wires should

either be well insulated or be left obviously bare. One can imagine that such a simple and straightforward point as this would not need emphasis, but cases have arisen in practice which show that there is need for this remark.

More than once portions of apparatus and conductors have been put into commission which appeared to be insulated, but which in reality were not so. For example, the case may be taken of the connection that is sometimes used on high-tension work when a concentric cable has to be divided into separate conductors. In one end of a cylindrical connecting-piece there is a metal plate with a hole in the middle, through which the inner conductor passes and to which it is sweated. The cable is usually taped right up to this plate, but, naturally, the plate itself cannot be insulated. The unfortunate feature of this matter is that when the cable is painted some of the paint is sure to get on to the surrounding plate, causing it to appear insulated, and the possibility of shock to an attendant incautiously handling such an arrangement is very obvious. Instances of this sort of thing can very easily be multiplied, but the instance given is quite sufficient to draw attention to the danger.

Turning now to the other part of the question, and dealing with the precautions that should be taken by the switchboard attendant himself to guard against electrical shock, it will be well known to most practical engineers engaged upon power work that the ordinary rubber gloves supplied for high-tension work are very clumsy, and many switchboard attendants are distinctly averse to wearing them. There is a considerable amount of reason for this, inasmuch as experience has shown that the danger of dropping tools from gloved hands upon adjacent surfaces at high potential almost counter-balances the alternative danger of bare hands. Where, however, gloves are provided and instructions issued that they must be worn, it is very important that these gloves should be tested regularly for insulation with at least $2\frac{1}{2}$ times their working pressure. This is usually done by almost entirely immersing the gloves in a lead-lined cistern containing water. The gloves are nearly filled with water, and a bare wire is put into each glove without touching it. The testing pressure is then applied between the wire in the glove and the lead lining in the cistern, and in cases where the gloves are defective the water inside the gloves will get very hot and will probably boil in a few minutes. It is essential in carrying out such a test that it should not be unduly hurried, but that each operation should be carried on for at least 15 minutes. The number of defects in gloves which are usually supplied, more especially if they have been used for a short time, is remarkable ; and the slightest pin-hole destroys their value. It would not be at all surprising if 5 per cent. to 10 per cent. of the gloves tested in this way broke down. The importance of such a rigorous test is apparent when it is remembered that in cases where gloves are used they quickly become coated on their inner surface with a film of moisture from the hand, which forms a conductor of electricity from every portion of the surface of the rubber which is exposed. In central stations there is usually a notice that gloves should be regularly tested, but it is, unfortunately, not so common to find that adequate facilities are provided for this purpose, and the rule therefore becomes practically a dead letter, to the danger of all concerned.

There is another point in this connection to which attention should be drawn. When men are working on high-tension apparatus, they are frequently very careful to protect their hands by rubber gloves and their feet either with rubber shoes or by standing upon an insulating mat or stool. They do not, however, exercise the same care with regard to their heads, and in working behind high-tension switchboards this is a source of much danger.

In such a situation there are live contacts above and below the eye level of the operator, and as his attention is focused upon the work which he has in hand, it is remarkable that more cases of shock from contact owing to this cause have not occurred.

The danger is heightened in cases where the air is dry, for even when the head itself does not touch any contact, the hair may be attracted by static electrification, and it would therefore appear that for work of the nature indicated some form of rubber head-dress should be supplied.

OUR CANALS.

[COMMUNICATED.]

Over three-score years ago the waterways of this country were in a far more prosperous condition than they are at the present time, as they then carried the bulk of the merchandise which was transported over the country. At the present time the canals carry about 5 per cent. of the traffic, against 80 per cent. carried by the various railway companies. These figures, although approximate, are about correct, and they tend to show the great decline of a business which was once a pioneer of the carrying trade. Conditions, habits and methods of transport have all changed, and with them has come the decay of the canal system, which was in times gone by such a prosperous concern. But is the decay of the canals due altogether to the changes mentioned above? Is the decay of our waterways in the true interest of the people and the commerce of this kingdom? These questions are important, and they are questions which have been dealt with by the Canal Commission, whose reports have been exhaustively discussed in this journal. Canal transport, although slow, is probably the cheapest known method of transport, and is admitted to be suitable for the heavier classes of non-perishable merchandise, and minerals, and also for grain, potatoes, &c., when such goods are not required urgently for the market. Cheapness of transport is essentially one of the most important factors in connection with the trade, because it is obvious that an increase in the transport charges means an increase in the cost of production and also an increase in the cost of the living of the people. The great disparity between the working cost and upkeep, and also the existing charges of the railways in comparison with the cost and charges of the canals clearly shows that the public may hope to gain considerably more benefit from the canals than many people would imagine. The fact of the matter is that the railways are in the unenviable position of having reached bed-rock with respect to the charges for railway carriage, and this is owing to the margin being so small, and inadequate to allow for further lowering of the railway rates. This state of affairs has been brought about by the increased working cost and the high prices paid for raw materials used on the railway. The result is that the public cannot expect any reduction in rates from the railway companies. At the same time it can safely be said that the trader may expect some benefit from the development of our inland waterways.

The report of the Royal Canal Commission is now published, and it may be said that the question of transport has been dealt with in an exhaustive manner ; after a long period of neglect it is likely that new life will be infused into the waterways, which is necessary, considering the importance of the carrying question.

The practical suggestion of forming a Central Waterway Board consisting of three or five Commissioners is likely to meet with general approval, although it is immaterial whether the Board consists of three or five Commissioners, as long as it is thoroughly representative and free from the railway influence which has paralysed canal enterprise and retarded the progress of our inland waterways.

It is essential that the work of the Board be progressive, and therefore persons connected in any shape or form with railway or other competing forces ought not to be allowed to act as representatives on the proposed Waterway Board.

It may be mentioned that at the present time the railway companies own about one-third of the existing mileage of the canals, with the result that most of them have been allowed to fall into decay and disuse. As a comparison showing how railway-owned canals are managed, compare the figures : Canals *not* belonging to railway companies, £216 net receipts per mile ; canals belonging to railway companies, £40 net receipts per mile.

The motive of the railway companies is quite obvious. The policy of purchasing canals and allowing them to fall into disuse, although expensive, has been very effective in reducing canal competition, so that the railway companies have had the carrying trade practically to themselves. Possibly the

strangulation of the canals has proved beneficial to the railway companies, but it is very doubtful whether the general public has received much benefit through the almost complete stoppage of canal competition. Looking back to some 60 years ago, we find that in those days the canals had the monopoly, and the traders considered that the railways were needed to compete with the canals just as much as the traders of to-day consider that something should be done to improve the canals so that they can compete with the railways.

So we see the position completely reversed, and the people are sufficiently wide awake to appreciate the fact that a monopoly in the carrying trade is not beneficial to the public.

Low transport charges are indispensable to the people of this country, and when the reader bears in mind the tremendous weight of raw material, foodstuffs, grain and manufactured articles, he will appreciate the trader's wish for lower freight rates.

All this foreign traffic has to be transported from the various ports in the kingdom and distributed to the more remote inland places, with the result that when the goods arrive at their destination, the cost of the railway carriage is often equivalent to 10 per cent. or 15 per cent. of the actual value of the goods.

Referring to the Report of the Royal Canal Commission, it proposed that four of the main canal routes be taken in hand for amalgamation and gradual but continual improvement.

Included in these four routes would be certain waterways which, when taken altogether, would connect the Midland industrial area, including such towns as Birmingham, Nottingham, Leicester and Wolverhampton, to the ports on the Humber, the Bristol Channel, the Thames and the Mersey; the canals comprised in the four main routes should be vested in the Board, and worked solely in the interests of the public.

The scheme embodied in the report provides for a service of barges with a minimum capacity of 100 tons varying up to 300 tons. The possibility of bringing 750-ton vessels up the Severn as far as Worcester, and up the Trent as far as Nottingham, is also considered; the traffic would then be transferred to these canals, raised to what is termed the 100-ton standard.

The scheme is estimated to cost £17,500,000, and the Commission suggests that the part required for the acquisition of canal properties be provided out of State funds, either as a free grant, or as a loan subject to long-deferred repayment.

The proposal is made that capital for the reconstruction of the canals be guaranteed by the State. It is noticeable that the railway representatives serving on the Commission object to State aid being given to the waterways, as one of them said that aid should be given to the railways instead of to the waterways.

For anyone to say that State assistance should be given to the railways instead of the canals proves that the suggestion emanates from a biased source. Moreover, it must be remembered that the public expect to obtain cheaper transport when the canals are in full swing, and, as explained earlier on, the railways are not in a position to provide cheaper transport; an impression is prevalent that only poor prospects are apparent of canals diverting much traffic from the railways, but such is not the case, provided that the old and obsolete methods of haulage are abolished and that improved methods of transport are substituted, with the latest facilities and improvements for loading and unloading minerals, &c. A good and frequent canal service is indispensable to the people of this country, and little fear need be entertained but that the scheme, as outlined by the Commissioners, will be a success and benefit both manufacturer and worker.

Kingswood Lighting.—The Electric Supply Co. has asked the U.D.C. for permission to use overhead wires for the supply of electricity, and points out that the carrying-out of the scheme largely depends upon the ability to use overhead wires, the cost of underground cables in a scattered district being prohibitive.

SOME GERMAN OZONE APPARATUS.

[BY OUR BERLIN CORRESPONDENT.]

Ozone, owing to its power of killing bacteria and destroying organic substances, has been applied successfully to the sterilisation of drinking water, and is also finding an increasing use for the purification of air.

Great strides have been made of late years by ventilating engineers, but the obvious drawbacks encountered have confined their task to certain limits. In fact, the thorough ventilation required to do away with the products of respiration accumulating in crowded rooms, frequently results in draught and inconvenience. Only chemical means are, therefore, capable of effecting a thorough purification of air by destroying the organic products of respiration and perspiration. Ozone, when diluted with air, has been found to be the most powerful chemical agent available in this connection, and being a modification of oxygen, the vital component of air, it incidentally regenerates the vitiated air.

The apparatus used for the production of ozone for the purposes of ventilation are similar in principle to those for producing oxygen for the sterilisation of drinking water, and are based on the ozonising effects of dark electrical discharges. Special attention should be paid to the concentration of the ozone, lest the amount mixed with a given quantity of air exceed a certain limit. In fact, this concentration need not by any means be very high, the most important point in connection with ozone ventilators being that the purifying (deodorizing) action be allowed to make

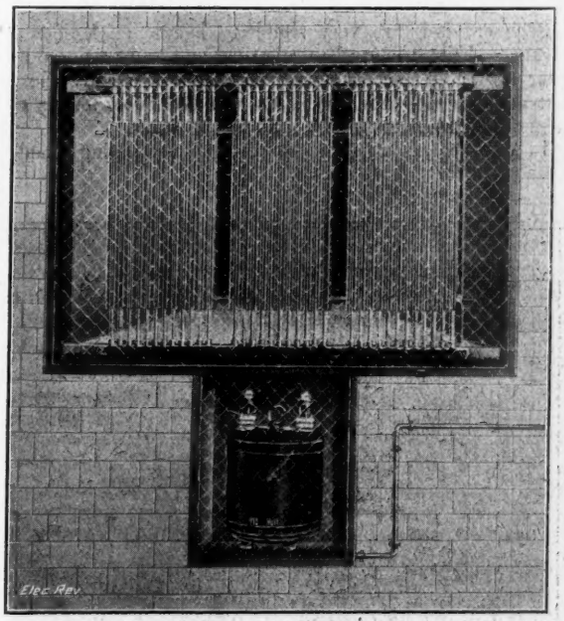


Fig. 1.—Ozoniser fitted in Ventilating Channel.

itself felt as fully as possible, which, according to previous experience, is obtained even with concentrations varying—according to local conditions—between ·05 and ·5 gr. per cubic metre.

The design of an ozone ventilator for a given building, depends on whether or not the building contains a central ventilating plant. If so, the ventilator should be fitted into the ventilating channels, as in fig. 1, showing an ozoniser provided with an iron framework of alternating metal rods and plates. The rods are surrounded with insulating glass, and each pair of rods and plates forms a pair of electrodes inserted in the high-tension circuit of an alternate-current transformer, one terminal of which, for the sake of safety, is connected to earth. During the operation of the apparatus, the dark discharge, produced between the plates and the glass-covered rods which manifests itself as a

faint bluish glow, ozonises the air streaming through the framework. This ozonised air then enters the room to be ventilated, mixing with the used-up air in the latter, and purifying it.

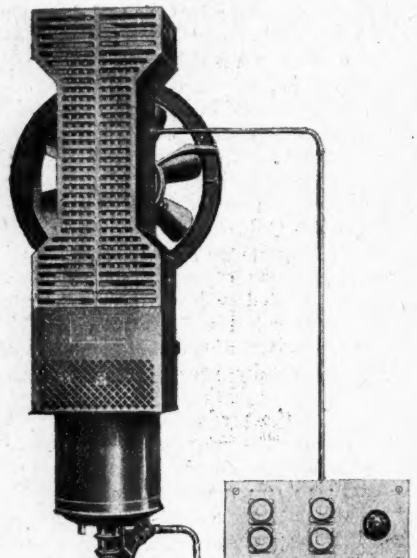


Fig. 2.—Wall Apparatus.

Fig. 3.—Small Ozone Plant.

Such ozonisers are very simple to handle, an incidental advantage being the excellent distribution of air produced by their means. The consumption of energy is relatively low, and an apparatus ozonising 1,000 to 5,000 cubic metres of air per hour requires only from 30 to 150 watts.

In cases where there is no central ventilating plant, keep the air in permanent motion, while throwing a large amount of it through the ozone apparatus, so as to permanently combine it with ozone. While being purified itself, the air traversing the apparatus is enabled to carry along enough ozone into the room in question to regenerate the air of the latter.

The ozone fan, represented in fig. 3, is readily connected like an electrical lamp to any existing mains. Any switches and fuses required for its operation are located on a marble slab fitted on its front. Fig. 4 represents an ozone fan used for a large workmen's dining hall.

Portable ozone ventilators (fig. 5) are similar in principle to the isolated apparatus above described. These are designed for special cases—*e.g.*, for use in hospitals, and, being readily transported from one room to another, they are specially advantageous in this connection.

The wall apparatus represented in fig. 2 shows some special features. Being fitted like an ordinary electrically-operated wall fan, into an opening in the masonry, it supplies from outside a stream of fresh air, the larger part of which is forced through the apparatus arranged in front of the fan, and is there ozonised. It thus serves a double purpose, supplying fresh air, rich in ozone which in its turn exerts a purifying action on the inside air.

In cases where very extensive plants are required, *e.g.*, for whole blocks, ozonisers supplying highly concentrated ozone (such as are used for water sterilising) may be found of advantage. The ozone is then produced in an apparatus distinct from the ventilating plant, and is afterwards mixed with air and forced, by the aid of a compressor, through the air pits or a system of conduits, into the rooms to be ventilated.

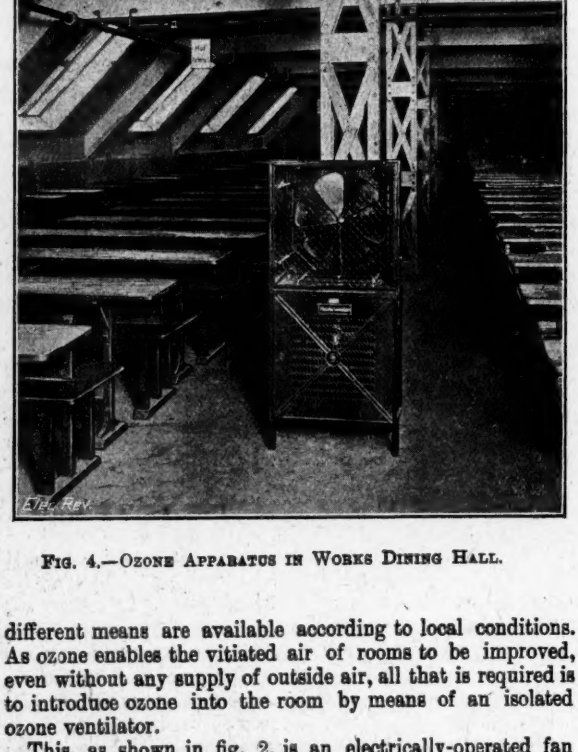


Fig. 4.—Ozone Apparatus in Works Dining Hall.

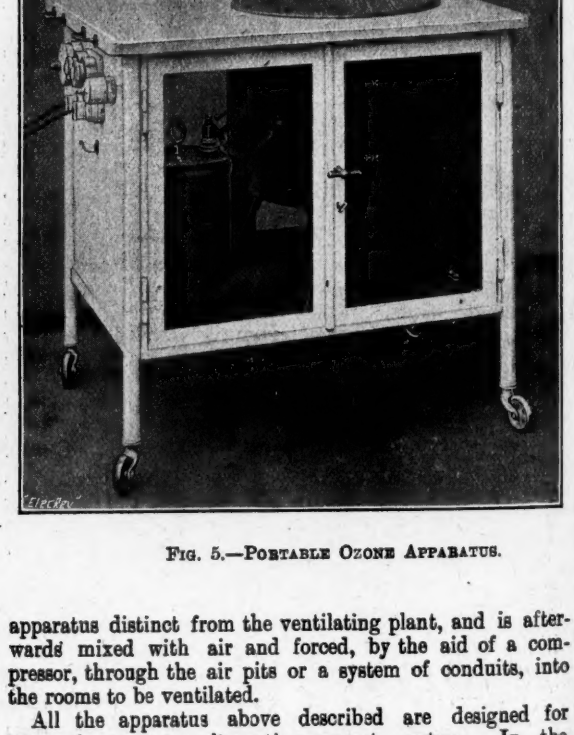


Fig. 5.—Portable Ozone Apparatus.

different means are available according to local conditions. As ozone enables the vitiated air of rooms to be improved, even without any supply of outside air, all that is required is to introduce ozone into the room by means of an isolated ozone ventilator.

This, as shown in fig. 2, is an electrically-operated fan fitted into a casing and conveniently combined with an ozoniser. The ventilator, like an ordinary fan, serves to

All the apparatus above described are designed for connecting to an alternating-current system. In the case of a continuous-current supply, they would be combined with a converter, preferably a single-armature

machine, either fitted into the apparatus or arranged outside.

These apparatus are being used successfully for purifying the air in theatres, music halls, restaurants and assembly halls. Ozone ventilation has further been used with advantage in the tunnels of a subway and on board vessels for improving the air in the steerage, and is being introduced into barracks, churches, schools and municipal asylums.

BUSINESS NOTES.

Consular Notes.—Argentine Republic.—The Belgian Legation at Buenos Ayres reports that the Argentine Republic undoubtedly deserves the very best attention of manufacturers desiring to develop trade in electrical goods. This country already imports 15,000 000 fr. value of electrical materials, and the use of electricity is becoming more and more general throughout the country. The Republic offers excellent opportunities for articles of all kinds for lighting, traction, telephones, telegraphs, industrial motive power, &c., and in the Province of Cordoba and the districts of the Andes the utilisation of water-power for electric lighting and motive force is becoming more and more general. Germany, Great Britain and United States have effectively worked the market up to the present. Local production may be said to be nil. The proportions of the trade held by the various countries are as follows:—Germany, 491 per 1,000; Austria, 3 per 1,000; Belgium, 14 per 1,000; Denmark, 1 per 1000; United States, 98 per 1,000; France, 36 per 1,000; Italy, 33 per 1,000; Norway, 1 per 1,000; Holland, 1 per 1,000; United Kingdom, 312 per 1,000; Sweden, 8 per 1,000; Switzerland, 2 per 1,000. The moment appears to be opportune for endeavours to obtain further trade.

Precise information as to the trade in electrical goods is extremely difficult to get, business men on the market being very wary of giving information. As regards wire and cable the official statistics give two headings; those dutiable at 27 per cent. *ad valorem*, such as wire and cables, of copper, covered with silk, of all diameters, including those not covered with silk, if their diameter does not exceed 5 mm.; also wire and cables of iron or steel covered with cotton, gutta-percha, &c.; and those dutiable at 5 per cent. *ad valorem, i.e.*, other wire and cables, including subterranean cables of copper covered with lead and armoured with iron or steel. The imports of wire and cables dutiable at 5 per cent. during 1908 were as follows:—Germany, 2,823,987 kg.; Belgium, 4,362 kg.; United States, 175,645 kg.; France, 8,773 kg.; Italy, 13,585 kg.; United Kingdom, 441,003 kg.; making a total of 3,468,155 kg., valued at 1,076,568 pesos. The total imports of wire and cables paying a duty of 25 per cent. *ad val.* were 412,584 kg., valued at 326,246 pesos, the chief supplying countries being Germany (146,058 kg.), United States (31,260 kg.), Italy (78,668 kg.), Belgium (14,860 kg.), and United Kingdom (126,739 kg.). Moreover, there were imported free of duty wire and cables to the extent of 211,361 kg., valued at 108,431 pesos from Germany (87,553 kg.), France (13,429 kg.), and United Kingdom (104,625 kg.). The imports of electric batteries amounted in 1908 to a value of 13,373 pesos, the principal suppliers being Great Britain and Germany. The insulators chiefly used in the country are those of porcelain, faience, &c., but America sends a certain number of glass insulators. The imports of porcelain, &c., insulators in 1908 were 449,271 kg., of which Germany sent 217,690 kg., France 40,676 kg., United Kingdom 181,334 kg. Argentina imported in 1908, 6,380 telephonic apparatus valued at 36,050 pesos. The chief supplying country is Belgium. This country appears to be losing ground in favour of Germany. Sweden and Great Britain also hold large shares of the trade. Electric bells are imported almost exclusively from Germany. Incandescent electric lamps are chiefly imported from Germany. The total imports are 126,543 kg., valued at 101,231 pesos, of which Germany supplied 73,079 kg.; United States, 24,113 kg.; and United Kingdom, 16,212 kg. Germany is also the largest supplier of arc lamps, Great Britain, France and the United States taking small shares; the total imports were 6,892 kg., valued at 103,854 pesos in 1908, of which Germany sent 4,821 kg. Germany supplies three-fourths of the imports of carbons for electric lamps, Great Britain, France and United States sharing the remainder. Dynamos and electric motors were imported in 1908 to the extent of 1,922,755 kg., valued at 576,823 piastres, of which Germany supplied 885,357 kg.; United States, 209,107 kg.; France, 104,209 kg.; United Kingdom, 921,232 kg.; Sweden, 51,119 kg. According to information obtained from a merchant, it appears that there is a larger demand for dynamos of 110 and 65 volts with different amperages, as well as for continuous-current motors of 2 H.P. and 220 volts. Above 2 H.P. all motors are of 440 volts. There were in Buenos Ayres on December 31st, 1908, 6,329 electric motors with a total of 35,931 H.P. The Argentine statistics show for 1908 imports of 4,876 small motors, complete or not, for fans, valued at 39,008 pesos, and coming chiefly from the United States. Electric fans are commodities of necessity in Buenos Ayres during the hot season. They are used largely, and even the smallest workmen's taverns possess them. The importation is increasing considerably, and in 1908 amounted to 4,757 kg., valued at 38,056 pesos, of which Germany supplied 187 kg.; United States, 2,827 kg. Italy, 1,039 kg., and United Kingdom, 694 kg. Germany, Great Britain and United States are the chief suppliers of electric meters. The total imports in 1908 were 7,398 kg., valued at 88,776 pesos, of which Germany supplied 3,391 kg.; United States, 368 kg.; United Kingdom, 3,062 kg. Under the heading, "Various materials for electrical purposes," which includes accumulators, &c., the total imports were 4,396 kg., valued at 508,463 pesos, of which Germany supplied 1,349 kg.; United States, 404 kg.; and United Kingdom, 2,055 kg. A German house does a very large trade in fixed accumulators, and there is said to be a good opening for portable accumulators. There is a large consumption of heating apparatus, and, as may be easily understood, the demand is regulated to a great extent by the price. All heating apparatus should be of 220 volts. The use of electric lifts is extending more and more in Buenos Ayres, thanks to the tendency to construct five or six-story buildings instead of the old one-story types.

Before making offers to importing houses established in Argentina, the question of price should be carefully considered, for the demand for electrical goods in the market depends to a great extent on their price. The large German and American houses make great sacrifices in order to introduce their goods on the market. Business is in part done through importing houses, who pay cash, but the biggest deals are made by direct representation through agents in Buenos Ayres. Almost all goods are sold by trade mark or manufacturer's name. A suggestion often made is that the good and regular quality of merchandise should be assured. This point deserves great attention, as does also the speedy and faithful execution of orders. Manufacturers desiring to open up trade with the Republic should send out samples of their goods, and should appreciate the necessity for establishing in Buenos Ayres a warehouse on their account and through their agents. Some houses import both general machinery and electrical goods, but others make a speciality of the latter, and it should be noted that all the large importers are already acting for certain houses. It should not, therefore, be forgotten that the importation of electrical goods is already an organised trade, and that great care will be necessary if manufacturers are to introduce new goods. The following is a list of the chief importers of electrical goods in Buenos Ayres:—

India-Rubber Gutta-Percha and Telegraph Works Co., 140, calle Reconquista.
Hemlein & Cia., 1,369, calle Rivadavia.
H. Kruger & Cia., 729, calle Florida (represents German firms).
Laborde y Cia., 368, calle San Martin.
Adolfe Laborde y Cia., 270, calle Florida.
Edmond Le Roy de Bonneville, 1,450, Casilla Correo.
Dante M. Ortelli, 1,134, calle Conesa.
Buxton Cassini & Co., 462, calle Cuyo.
Otto Hess y Cia., 667, calle Florida (electromedical apparatus)
E. Rall, 556, calle Bartolomé Mitre.
Juan Quevedo, 826, calle Cangallo.
S. American General Electric Supply Co., 531, calle Cuyo.
Agur Cross y Cia., 955, calle Cuyo.
Juan & Jose Drysdale y Cia., 440, calle Peru.
Adolfo Mantels y Cia., calle Belgrano Esquina Peru.
Luis Lindelof y Cia., 344, calle Victoria (respresents foreign firms).
Azaretto Hermanos, 1,901, calle Cuyo.
Fuhrken y Bechtel, 928, calle Alsina (agent for "Watt" lamps Vienna).
Bartram y Cia., 1,147, calle Cuyo.
A. Delest, 504, calle Lavalle.
Paul Peters, 932, calle Corrientes (represents a German firm).
Peters y Fruchttenicht, 1,278, calle Bartolomé Mitre.
Clair y Anglade, 437, calle Defensa.
Anezin Hermanos y Cia., 211, calle Esmeralda (house at Paris).
Moore & Tudor, 138, calle Maipu.
Sociedad Electro-Tecnica Argentina, 647, calle Corrientes.
Pablo I. Alegre, 2,941, calle French.
Berthold y Cia., 1,286, calle Bartolomé Mitre.
Alberto Hahn Hijos, 1,870, calle Cangallo.
Heynemann y Cia., 321, calle Esmeralda.
Hinz Hermanos, 1,038, calle Cuyo.
Walter Kohlstedt, 487, calle Moreno.
Enrique Lepage y Cia., 375, calle Bolivar.
A. Scapusio y Cia., 570, calle Suipacho.
Brauss Mahn y Cia., 80, calle Reconquista.
Otto Franke y Cia., 535, calle Corrientes.
Geiger Zublin y Cia., 760, calle Chile.
Rodolfo Kaufmann, 320, calle Reconquisto.
M. Richt y Lehmann, 815, calle Cangallo.
Schill Pearson y Cia., Ltd., 329, calle Barcarcé.
H. Straube y Cia., 1,701, calle Cangallo.
Companhia Industriel de Electricidad de Rio de la Plata, 432 calle Belgrano (represents a German and an Italian firm).
Orido Casati, 2,147, calle Cangallo.
Fitte Hermanos, 834, calle Moreno.
Max Glucksmann, 375, calle Bolivar.
L. Bernardino Pardo, 932, calle Esmeralda.
A. Parcus y Cia., 317, calle Defensa.
Carlos Pugni, 655, calle Corrientes.

The following are importers at Rosario de Santa Fé:—
Chiesa Hermanos, 1,046, calle San Lorenzo.
Moore & Tudor, 745, calle Paraguay.
Remonda Montserrat y Cia., 548, calle Entre Rios.
Anezin Hermanos y Cia., 891, calle Cordoba.
Sociedad Electro Tecnica Argentina, 821, calle Cordoba.

The following are importers at Bahia Blanca:—
Alberto Aceto, 33, calle Rondeau.
Frigerio Rocco y Cia., 365, calle Chiclana.
Julio Gary, 129, calle San Martin.
L. & A. Horn, 367, calle Santa Fé.
W. Clivet y Cia., 45, calle Chiclana.
Reid y Cia., 211, calle Chiclana.

Agents at Buenos Ayres:—
E. Hardy & F. Muhlenkamp, 362, calle San Martin.
P. Vander Ahote, 754, casilla de Correo.
Pablo Coster, 849, calle Maipu.
H. Paternoster, 1,046, calle Cangallo.
Leon Hecquet, 890, calle Alsina.

Of the lighting, tramway and electric power, telephone and telegraph undertaking in Argentina the Cia. Alemana Transatlantica de Electricidad, of Buenos Ayres, is the most important. It is a branch of the Allgemeine Elektricitäts Gesellschaft, of Berlin, and supplies electric current for various purposes to almost the whole of Buenos Ayres. In 1908 it had 24,803 subscribers. The equivalent of the electricity connections of this company in lamps of 16 c.p. is 713,090 for lighting and 503,000 for motive power. It costs 12·02 pesos per unit for lighting, and 6·76 pesos for motive power. The current for lighting is continuous at 220 volts, or alternating at 225 volts; the current for motive power is continuous at 440 volts. The electrical energy distributed was 25,966,133 units for lighting private establishments, 10,707,670 for motive power, 2,073,444 for public lighting, and 45,833,257 for tramway purposes. The company is at present constructing, at Buenos Ayres, new works which will be one of the largest in the world. The engines will have an aggregate capacity of 120,000 H.P. The principal tramway company in Buenos Ayres is the Anglo-Argentine. Part of the capital of this company is Belgian, the administration is Belgian, and the headquarters are at Brussels. The company is the result of the fusion of the old companies—Belga Argentina, Capital, Gran Nacional, Tramway Electrico de Buenos Ayres, Buenos Ayres y Belgrano, and Metropolitano. It is, it appears, the second largest company in the world, the largest being in Berlin. It possesses 2,300 cars, of which 1,500 have motors and 800 are trailers. All the electric tramway lines in Buenos Ayres are on the trolley system. The current is supplied by the German company referred to above, the Anglo-Argentina having only sub-stations for the transformation of the current. The Cia. de Tramways Lacroze, of 4,002, calle Corrientes, Buenos Ayres, has its own works for the production of electrical energy, and distributes current to certain private establishments. The following companies may also be mentioned:—The Cia. de Tranvias Electrico del Sud, 1,327 calle Brasil, Buenos Ayres; the Sociedad de Electricidad de Mendoza Luz y Fuerza, which utilises the water power of the Mendoza river; the Cia. de Luz Electrica y fuerza motriz de Cordoba, of 761, Avenida de Mayo, Buenos Ayres; the Cia. General de los Tramways Electricos de Rosario, 126, Casella Correo, Rosario de Santa Fé, which is Belgian, with headquarters at Antwerp, and supplies power from its own works; the Cia. Luz Electrica Traccion del Rosario, 354, calle San Martin, Rosario de Santa Fé, which supplies current at 220 volts for lighting, heating, &c., for the whole of Rosario; the Usina de la Luz Electrica del Puerto de Rosario, at Rosario de Santa Fé; Tramways Electricos de la Plata, at La Plata; Cia. de Electricidad del Plata, 132, calle San Martin, Buenos Ayres (works at Mar-del-Plata); Cia. Primitiva de Gaz y Alumbrado Electrico de Buenos Ayres, Ltd., 947-63, calle Cuyo, Buenos Ayres; Cia. Constructora de Tramways Electricos de Cordoba, 564, calle Cangallo, Buenos Ayres; Cia. Ferro Carril Pacifico, which has electric tramways at Bahia Blanca, with its own works, and supplies electrical energy for lighting and power, with three-phase alternating current at 380 volts for motors and two-phase alternating current at 220 volts for lighting, fans, &c.; the Sociedad Anglo-Argentina de Electricidad, 325 calle Reconquista, Buenos Ayres, with works in several towns of the Republic; Tabossi & Cia., of Parana; La Electrica de Norte Luz Electrica de Tucuman y Santiago del Estero, 449, calle Esmeralda, Buenos Ayres; Manuel Leiva, of Victoria, Entre Rios; Cia. Luz Electrica de Gualeguaychu, of Gualeguaychu (H. R. Buxton & L. B. Trant), which installs motors and distributes energy for small industries and pumping plants; the Cia. General de Electricidad de la Provincia de Cordoba, of Cordoba, formed some months ago to utilise the water-power of the San Roque and Molet dams; the Cia. de Tramways Buenos Ayres y Zuilmes, 961, calle Cuyo, Buenos Ayres; Union Telefonica, 1,193, calle Rivadavia, Buenos Ayres; Co-operation Telefonica, 1,394, calle Cangallo, Buenos Ayres; Telegrafo Nacional, 424, calle Corrientes, Buenos Ayres; Cia. Telegrafica Telefonica del Rio de la Plata, 228, calle Reconquista, Buenos Ayres; Telegrafo de la Provincia de Buenos Ayres, 49, calle 25 de Mayo, Buenos Ayres; Cia. Telegrafica de Centro y Sud America, 501, calle Cuyo, Buenos Ayres.

Cuba.—The Belgian Legation at Havana reports that the imports of electrical machines and apparatus into Cuba are quite considerable, and may be expected to develop. The figures given in the Cuban Statistics under the headings "Electric Machines" and "Electric Lamps" are considerably less than the total value of the imports of electrical machines and apparatus in general. The averages of the years 1905 to 1907 show that the imports of electrical machines are $70,000 annually. In this total the United States accounts for $50,000, Great Britain for $18,000 in 1905-6 and $2,500 in 1906-7, France for $3,000, and Germany for $2,500. The imports of lamps show an annual value of $40,000, of which the United States accounts for $24,000, Germany for $10,000, France for $2,300, Great Britain for $400, Spain for $350, Belgium for $300, and Switzerland for $25. A certain number of articles for electrical purposes, such as wires and cables, porcelain goods, switchboards, telephonic apparatus, &c., are included under other headings in the trade returns, consequently it is not possible to ascertain the amount of these. Electric lighting has been adopted in many parts of Cuba, and its use is constantly extending, not only in the towns but also in the villages. Electric lighting is also used in certain sugar works. Havana (300,000 inhabitants) and Santiago de Cuba (50,000 inhabitants) are provided with electric tramway systems. The Havana Central Railroad Co., moreover, exploits certain electric railway lines in the district surrounding Havana. A project was recently laid before the municipality of Cienfuegos (30,000 inhabitants) by Mr. A. Betancourt, for the installation in the town of an electric lighting and tramway system. A year is said to be necessary for the completion of the works. Tramway material is imported almost exclusively from the United States. The cars of the Havana Electric Railway Co. are erected in the works of the company with trucks and motors (15 H.P. 500 volts) supplied by American houses. The bodies are built in Cuba. The aerial apparatus, including the cables are supplied by the United States, as a general rule, but Germany supplies certain cables. The preference given to the United States is the result, in the first place, of the rapidity of communication between the two countries, then again to the Customs advantages granted to American goods, and finally in a general way to the American influence in all Cuban affairs. One may mention that American firms send very complete catalogues profusely illustrated, in which those interested may find immediately the article which they need, and a quotation of price. Moreover, the existence in Cuba of several representatives, some with warehouses and some without, from the chief electrical firms in the United States, adds much to the promotion of trade. The dynamos most in demand are those of 10 to 50 KW., giving continuous current at 125 volts. The majority come from the United States. As examples of price the following may be quoted:—A dynamo of 25 KW., with rails and rheostat packed f.o.b., New York, $300; a dynamo of 40 KW., with rails and rheostat packed, $430. For important installations, recourse is had to Germany. The two generating stations, which supply current for the electric lighting of Havana, were supplied with dynamos by a German firm. At Guanabacoa, opposite Havana, on the other side of the bay, the electric station is supplied with dynamos and gas engines from Germany. The electric motors most in demand are of the single-phase alternating-current type of 110 volts and three-phase alternating current of 220 volts, from ¼ H.P. to 7 H.P. and above. There is in particular an opening in Havana for small motors of from ½ H.P. to 1 H.P. for use in a great number of houses to work a pump for raising water to upper floors. These motors are actually on sale at $38 retail. Competition is fairly keen. For some time motors of this kind produced by an Italian firm have been on sale at Havana, and easily compete with the American product. The Italian firm in question has a representative on the spot. Electric fans are in general use; they are supplied chiefly by the United States, Germany and Italy. Incandescent electric lamps are imported in large quantities from the United States, but could easily be supplied by European houses. The carbon-filament lamp is in general use, but there is a good opening for metallic-filament lamps. The following prices may be quoted for large sales:—Lamps of 16 c.p., 75 centimes for superior quality American product, and 32 centimes for ordinary quality French product. Arc lamps are much less generally used, and are supplied by American houses. European competition is, however, very possible, and a good opening is probable with the sugar works. Prices are generally quoted f.o.b. at the port of embarkation. Some German houses quote c.i.f. Havana, and this system is preferable, although not necessary. It is wise not to quote a price at the works, as this method does not allow the purchaser to calculate his profits. American houses give a credit of about 30 days, with 2 per cent. discount. After extended relations it is often the custom to give even better terms. The German houses usually give 90 days, but the trade in lamps is often cash. The following are the electrical undertakings and electrical firms at Havana: Cia. de Luz e Electricidad de la Habana; Havana Electric Railway Co.; Havana Central Railroad Co.; Pablo Delaporte, 85 calle O'Reilly, Havana (French house); A. H. Thrall, Hotel Plaza, Havana (American house); Jose M. Zarrabeita, 19 calle Mercedeires, Havana; A. G. Bærnsteen, 34 calle Obrapia, Havana; G. Hempel, 95 calle Aguiar, Havana; Sundorf Zaldo, calle Cuba, Havana (agent of the Allgemeine Elektrizitäts Gesellschaft, Berlin); J. M. Planas, engineer, 50 calle San Ignacio, Havana. The following houses deal in machinery in general for sugar works:—P. Boulanger, calle Habana esquina O'Reilly, Havana; P. Droeshout (Belgian engineer), 30 calle Empedrado, Havana. Three methods may be suggested for endeavours to introduce electrical goods in Cuba: (1) Supply of very detailed catalogues, profusely illustrated and with notes of prices. The study of American catalogues is very suggestive, and may be recommended. The prices quoted on American catalogues are inflated, and leave to the supplier a margin of from 10 per cent. to 30 per cent., and sometimes even more, which may be utilised for granting reductions. This system is much preferable to that of sending catalogues without price, or even with an appendix giving prices. (2) The sending to the country by one house, or by several houses combined, of a traveller speaking Spanish, who, having entered into relations with the firms interested, could appoint a permanent representative before leaving. (3) The establishment at Havana of a warehouse for the sale of goods. It is, in general, useless to attempt to effect business by correspondence, since the country is carefully worked by Americans and Germans. As to duties, dynamos and detached parts, motors, ventilators, telephonic apparatus, bells, &c., pay a duty of 20 per cent. if of American origin, and 25 per cent. if of other origin; incandescent lamps pay

$2·44 per 100 if of American origin, and $3·25 per 100 if of other origin; wires and cables pay $7·50 per 100 kg. if of American origin, and $9·38 per 100 kg. if of other origin.

Italy.—The British Consul at Rome reports that the principal hope for the manufacturing industries of Italy in the future lies in the development—at present almost in its infancy—of the immense hydraulic resources of the Alps and Appennines. Should the problem of utilising the magnificent stores of energy with which nature has endowed this country be attacked with enterprise and science, the cost of production would be enormously reduced, and there should be nothing to prevent her competing on favourable terms in the markets of the world. So long as her manufacturers have to depend upon imported coal for the supply of energy, they can hope to do little more than cater for the home market with the aid of a high protective tariff.

Switzerland.—The British Consul at Vaud and Valais reports that in the Canton of Valais, owing to the utilisation of the Rhone and other rivers, a great impetus has recently been given to industry. Up to date the Communes and the Government have sold water grants for 133,000 H.P. at low water, of which about 65,000 H.P. are already employed for the manufacture of carbide, ferro-alloys, sodium and other chemical products.

The Aluminium Industry.—The estimates made on the German Stock Exchanges as to the probable dividend of the Neuhausen Aluminium Industry Co. for 1909 range between 12 and 16 per cent., but a Zurich newspaper asserts that the company's profits on manufacturing will only exhibit a slight reduction as compared with the preceding year. This circumstance will render it possible, taken in conjunction with the balance brought forward and with the considerable reserves accumulated in favourable years, for the company to maintain the distribution at 18 per cent. as in 1908. A material improvement in the conditions of the market is expected this year, especially as a large increase of prices has already taken place in recent months. Thus the quotation recovered to £3 10s. per cwt. in the middle of January, as compared with £3 in the final quarter of 1909, the cause being found in the brisker demand on the part of the consumers in order to cover their requirements. Since then the quotation has advanced to £3 12s. 6d., and a fresh rise to £3 14s. is now reported to have taken place. The condition of the market is in the circumstances regarded with confidence in Switzerland and Germany, and the idea of reconstituting an international syndicate has not been abandoned in these quarters. On the other hand, the French producers of aluminium are by no means pleased with the attitude of the Committee appointed by the Senate to consider the new business tariff which has been adopted by the Chamber of Deputies. The Committee considers that the possibility exists of largely reducing the import duty on the metal, but the French metallurgical interests submit that the effect would be the stifling of one of the most favourable national industries. After the United States, France stands at the head of the other producing countries, and it is contended that if the proposal of the Commission were agreed to, the Americans would invade the French market and cause prices to fall for a sufficiently long period to ruin the French works, on the accomplishment of which the Americans would gather the fruits of their perseverance, and prices would gain the former level and then be further increased. The Americans have a protectionist barrier of 4d. per lb. on ingots, and it is urged that they are therefore able to attack foreign rivals in the latter's home markets by covering losses through the margin of profits realised in the United States market.

Record Life of an Osram Lamp.—At noon on April 11th, 1908, an Osram lamp of 100 C.P. was switched on at the Stafford Corporation Electricity Works. It burnt continuously from that time until 10 p.m. on January 22nd, 1910, when it failed, after a life of no less than 15,643 hours. It was burning at its proper voltage, and gave a good light right up to the end. We have a similar 100-C.P. Osram lamp in our publishing office, which has been on circuit for over two years, burning 50 hours a week at 200 volts, and apparently none the worse for it.

At Home.—The Central Electrical Engineering Works (Messrs. William McWhirter & Son), Glasgow, held their annual "At Home" on Friday evening the 18th inst. The employés and friends present numbered about 120.

Book Notices.—*Questions and Solutions in Telegraphy and Telephony.* Second edition. By H. P. Few. London: Rentell and Co. Price 2s.—The first edition of this little manual appeared just over 12 months ago, and it was reviewed in April. In that review we commended the writer and welcomed him to the ranks of technical authors, and adduced sundry reasons for the success of the book. We have now merely to repeat that commendation and remark that our judgment was evidently not at fault, for before a year has elapsed the first edition appears to have been absorbed. In our previous notice we had occasion to indicate the existence of certain inaccuracies which, as usual in first editions, had been allowed in the text. We are glad to observe that these have disappeared, although there are one or two statements in this edition with which we are not entirely in agreement, having in view that they occur in the shape of model answers to examination questions. The author has included in this edition answers to the 1909 papers, and we feel quite safe in saying that it should be early in the hands of both teachers and students who are engaged on work for the 1910 examinations.

The Technology of Soldering Metals. By Engineer S. Ragno. Milan: U. Hoepli. Price 2 lire.—This very useful and instructive little book is divided into seven chapters, dealing fully with many problems about which there is considerable difficulty in finding well-written and accurate explanations. Moreover, the explanations that are sometimes given of soldering and welding processes are not always unbiased, whereas the author has treated the subject impartially from beginning to end, without any desire to commend one system at the expense of another. Engineer Ragno has carefully studied each system and practically tested it in operation, so that his written description is frequently supported by data as to how the best results can be obtained with varying conditions. Electric welding is given a chapter to itself with diagrams of connections; the arc will give a temperature of about 3,600° C., and for welding bars of iron or steel up to about 1¼ in. diameter a pressure of 30 to 50 volts, with 100 to 450 amperes, will be found suitable. Other chapters deal with oxyhydrogen and oxyacetylene welding, work on aluminium, classification of solders, an appendix on cutting metal with the oxygen jet, and a final chapter on various methods of producing oxygen. Several illustrations are given, and a similar book at a similar price in the English language would no doubt prove of great utility to many engineers who now use one or other process without having any available information as to the genuine relative advantages or disadvantages of other systems.

"*Journal* of the Institution of Electrical Engineers." Vol. 44, No. 199. 1910. London: E. & F. N. Spon. Price 5s.—This part contains the addresses of the President and the chairmen of local sections, as well as the following papers: The Present Aspect of Electric Lighting (Messrs. Handcock and Dykes); Electric Ignition of Internal Combustion Engines (J. W. Warr); Low-Tension Fuses (W. T. MacCall); Flicker Photometer for Coloured Lights (H. Morris-Airey); Metallic-Filament Lamps (F. H. R. Lavender); and a number of original communications.

"Les Compteurs Electriques à Courants Continus et à Courants Alternatifs." By L. Banbillion. 1910. Paris: Gauthier-Villars. Price 3 fr. 25 c.

"Notions Fondamentales sur la Télégraphie." By Albert Turpain. 1910. Paris: Gauthier-Villars. Price 5 fr.

"Du Téléphone Bell aux Multiples Automatiques." By Albert Turpain. 1910. Paris: Gauthier-Villars. Price 5 fr.

"Fruit." By W. Iggulden. 1910. London: Agricultural and Horticultural Association, Ltd. Price 1d.

"*Bulletin* of the Société Belge d'Electriciens." No. XXVII. February, 1910. Brussels: Ramlot Frères et Sœurs.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXIX, No. 3. March, 1910. New York: The Institute. Price $1.

"*Proceedings* of the Engineers' Club of Philadelphia." Vol. XXVII, No. 1. January, 1910. Philadelphia: The Club.

"Bolletino della Mostra Politecnica Espositione Permanente, Milan." No. 1. January and February, 1910. Price L. 0·50.

New Siemens Lamps.—Messrs. Siemens Brothers Dynamo Works, lamp department, Tyssen Street, Dalston, inform us that they are about to introduce a range of high candle-power metallic-filament lamps, having an efficiency of about 1 watt per candle; lamps of 100-C.P. will very soon be on sale, and will quickly be followed by others up to 600 C.P. The new lamp will be known as the "One-watt" lamp.

Trade Announcements.—Messrs. Marryat & Place have appointed Mr. A. L. Lanneau, of 52, Rue Zerezo, Brussels, their sole representative for automatic electric passenger and other lifts for Belgium.

Messrs. Davis-Perrett, Ltd. (electrical oil eliminating patents), have removed to Caxton House, Westminster, S.W.

In addition to their limiters, Mr. Arthur P. Haslam, M.I.E.E., Messrs. Nalder Bros. & Thompson's representative, is handling the N.C.S. automatic leakage switch.

We are informed by Messrs. Electrical Installations, Ltd., of Bassishaw House, Basinghall Street, E.C., that they have no connection whatsoever with a firm of similar name, who called a meeting of their creditors in Manchester last week.

Wind Turbines.—Messrs. J. G. Childs & Co., Ltd., have sent us particulars of an electrical installation in the Canary Islands, lighting the residence of a banana planter, which has been supplied by them and erected by a local engineer to their instructions. In a recent letter to them, the owner writes that the "wind-turbine electric plant is working satisfactorily." At the time of writing he had been using the light in the house and stables for a month, and found it all that could be desired; he also used electric power to drive a cream separator, churn and ice-making machine in the dairy, and to supply an electric iron, a kettle and a fan in the house, and finding that he had more than enough current, he was thinking of installing an oat-crushing machine. "The automatic operations are so perfect that the plant requires but little attention," he says.

Meeting of Creditors.—Frederick J. Borland, lately trading as an electrical engineer as Frederick J. Borland and Co., and as a hardware merchant (as the Excelsior Stores) at Old Mills, Camp Road, Leeds.—A meeting of creditors was called for Wednesday, March 23rd, at 3 p.m., for a statement of affairs to be submitted. Particulars of accounts to Mr. Percy Pemberton, incorporated accountant, 7, Greek Street, Leeds.

A Protracted German Liquidation.—A further stage has been reached in connection with the Helios Electricity Co., of Cologne, which has been in course of liquidation for a number of years, and whose manufacturing works were purchased by two other German firms and closed several years ago, so as to prevent the possible resuscitation of a competitor under new auspices. This transaction left the company in possession of a large interest in various supply works and tramways, and the object of the liquidators has been to dispose of these assets as soon as possible. All efforts made to realise the investments in one block have proved futile, and they are consequently being sold in instalments. The company's interest in Russian undertakings at St. Petersburg was recently disposed of for £442,000, as compared with a book value of £558,000, and the participation in the Wermelskirchen electricity works and a portion of the share held in the Crottorf works have also been realised. A transaction has now been arranged whereby the Company for Electrical Investments and the Electric Light and Power Investment Co., of Berlin, became the purchasers of the Helios Co.'s holding in the Landsberg, Stralsund, Thorn and Eisenfeld electricity works and tramways, which will produce over £160,000, whilst the buyers will also take over at par the company's claims against these works. These will also yield a considerable sum for adding to the amount of the purchase price and will enable a further instalment to be distributed among the creditors in the course of the next few months. The liquidators still have other interests to dispose of, although these are of a less realisable character than those which have hitherto been sold.

Willans Impulse Turbines.—As is now generally known, Messrs. Willans & Robinson have recently placed on the market a turbine of the plain impulse type, and also a turbine of the impulse disk and drum type; these two types of turbine, in conjunction with their well-known Willans-Parsons turbine, are intended to meet the varying requirements with which turbine manufacturers are daily confronted. Orders for turbines of the plain impulse type are at present under construction for the Ashton-under-Lyne Corporation, Messrs. Charles Moore & Co. and others; whilst turbines of the impulse disk and drum type are in hand for the Belfast Corporation, the Calcutta Electric Supply Co., the Bridlington Corporation and others. Particular interest is attached to the decision of the Belfast Corporation to extend its tramway plant by the addition of a 1,500-kw. Willans impulse disk and drum type turbine, coupled to a direct-current dynamo, in view of the strong opposition brought forward against the the adoption of direct-current turbines when the previous contracts were settled during February, 1907. On a previous occasion two units of 1,000-kw. were required, and the feeling expressed in many quarters at that time was in the direction that *direct-current* turbo-dynamos were not sufficiently reliable for purposes of meeting the requirements of a tramway load. After considerable discussion, the Belfast Council finally decided to place themselves in Messrs. Willans & Robinson's hands for the supply of two 1,000-kw. direct-current turbine units. These units have now been in daily operation for some two years, and it is generally known that the performance of the dynamos compares favourably with the best results obtainable with dynamos running at more moderate speeds. As a result, Mr. Bloxam, the Belfast engineer, has recommended his Council to install a further unit of 1,500-kw. capacity, and as it is intended to obtain this output from one dynamo (and not by installing tandem dynamos, as has previously been the case when dealing with this output), the present unit will be the largest single direct-current turbine set installed in this country, being somewhat larger than the two 1,200-kw. units which Messrs. Willans & Robinson have in hand for the Admiralty for the Devonport Dockyard.

Catalogues and Lists.—The Electrical and Trading Co., 17, Bouverie Street, Fleet Street, E.C.—Net price pamphlet of lampholders, ceiling roses, switches, bells, cables and other accessories for lighting and power.

The Electric and Ordnance Accessories Co., Ltd., Aston, Birmingham.—Card giving latest list prices (reduced) of "EOA" metallic-filament lamps.

Messrs. Michael Pal & Co., Parliament Mansions, Victoria Street, S.W.—Thirty-eight-page catalogue just issued, giving full descriptive matter, drawings and half-tone views of Schwarz (Dortmund) patent low-pressure turbine plants, blast furnace gas-cleaning plants, condensers and cooling towers.

Mr. Robt. W. Paul, Newton Avenue Works, New Southgate, N.—A set of catalogue sections fully describing and illustrating, and stating prices of apparatus for the measurement of inductance, effective resistance and capacity. The instruments which embody the latest developments are constructed for rapid and accurate measurements, and sets have already been supplied to the Post Office Telegraphs, the National Telephone Co., B.I. and Helsby Cables, Ltd., the I.R., G.P. and Telegraph Works Co., and many other leading firms.

Messrs. Ward & Goldstone, Sampson Works, Salford, Manchester.—Twenty-four-page illustrated catalogue of the firm's numerous electrical manufactures for the motor-car and motor garage. Small electric lighting and charging sets, batteries, the "Hydranamo" charging set, ignition accumulators and coils, meters, Osram lamps, motor-car lanterns, electric motors, motor-car wires, sparking plugs and a variety of sundries. Loose leaflet shows the "Guardian" pendant lampholder, and a third publication contains a full description of the "Facile" dynamo for the car, of which we give particulars and an illustration in our "New Devices" section in this issue.

The Foster Arc Lamp and Engineering Co., Ltd., Worple Road, Wimbledon.—Price list of Foster auto-transformers, which have been further improved, so that the no-load losses of a 300-watt 200/25-volt transformer, at 50 cycles, are listed at only 5 watts, with an efficiency of 94-96 per cent. at full load. The prices have also been reduced. The same list describes the Foster automatic transformer switch and electric bell transformer.

Messrs. Mather & Platt, Ltd., Manchester.—List describing and giving a list of outputs for their "P" type motors fitted with commutating poles, of which particulars were given in our issue of March 11th, 1910.

Allgemeine Elektricitats-Gesellschaft, Berlin.—Several pamphlets, dealing with the application of portable electrical apparatus to agricultural operations, such as thrashing corn, chaff cutting, &c.; also small electric locomotives for narrow gauges and pressures of from 110 to 2,000 volts, the power installed being from 4 to 550 h.p. The bulk of these locomotives (of which a list of nearly 180 sold up to the end of last year is given) are for a gauge of 500 to 750 mm., and a pressure of 200 or 500 volts, with motors averaging 20 or 30 h.p. Another list relates to full-gauge locomotives, of which the A.E.G. has supplied 955, of over 50,000 h.p., for overhead supply or accumulator traction. Two larger productions deal respectively with aluminium cells as surge-pressure arresters, for various pressures up to 77,000 volts and in various combinations, and with the application of electric motors to the individual driving of spinning frames, looms, &c.—a direction in which the A.E.G. has accomplished a surprising amount of work, a list being given of over 120 firms supplied, and no fewer than 16,314 motors, used for driving textile machinery—a splendid record.

Exhibition.—We are informed that Sir David Gill, K.C.B., F.R.S., has accepted the presidency of the forthcoming Naval, Mercantile Marine and General Engineering Exhibition.

Bankruptcy Proceedings.—Thomas Ward, 22, Totteridge Road, Enfield Wash, Ponder's End, Middlesex, lately carrying on business as a director of the Electrical Instrument Manufacturers, Ltd., at Freezywater, Waltham Cross, Hertfordshire. This debtor attended at the Court House, Upper Edmonton, on Wednesday last, for his adjourned public examination. The examination had previously been adjourned owing to the debtor's ill-health. The Official Receiver stated that he was informed that the debtor was acting as manager of a company at Canonbury, that he was attending regularly to business, and went to the City every day, and was to be found every evening in a saloon bar of a hotel. The debtor filed an affidavit denying these statements, with the exception of that relating to his visits to a hotel, which he said were made on the advice of his doctor, in order that he might obtain society. The hotel proprietor was a friend. An affidavit by the debtor's doctor was also put in stating that the debtor was of a distinctly neurotic temperament, and suffered from a weak, irritable heart, which was easily excited by any disturbing influence. In the doctor's opinion, if the debtor were subject to any shock or strain to his nervous system, such as going through an unpleasant public examination, the consequences would be very serious for him, and possibly fatal. He told debtor that it would be beneficial to him to have social enjoyment, as a solitary life would be prejudicial to his health. The Official Receiver expressed himself as not satisfied with the doctor's statement, and strongly urged that the public examination should be proceeded with. Every care and attention would be shown to the debtor. He regarded the case as a very important one. Mr. Moeran, for the debtor, said that when the previous examination took place the debtor was examined by the Official Receiver's medical adviser, and upon his report the Judge said he would not take upon himself the responsibility of having the debtor publicly examined. After some further discussion, the Registrar ordered the examination to be held on some date next month at the Official Receiver's office, Bedford Row, W.C., the proceedings to be conducted in private.

Wycliffe Galland Everingham, electrician, 37, Auckland Road, Ilford, Essex.—The receiving order in this matter was made on the debtor's petition, and the statement of affairs showed gross liabilities £746, of which £689 is expected to rank. The assets are expected to produce £93, the estate thus showing a deficiency of £596. The debtor, it appears, started trading in November, 1906, with another person at 12, Wigmore Street, as an electro-surgical manufacturer, under the style of Everingham & Boakes. The debtor put about £550 into the business, he having to borrow £500 from his father to do this, and none of the £500 has been repaid. The partner, debtor states, put in practically nothing, and the partnership was dissolved after two years, debtor taking over the liabilities and assets. A month later two other persons joined the business, bringing in about £250 capital, and the trading name was changed to the Electro-Medical Co. This partnership was dissolved the following year, the debtor's partners agreeing to wind up the business and account to him. Since June of last year the debtor has been employed at a salary. The books of account kept by the late firm of Everingham & Boakes comprise cash book and sold ledger and copy invoice book. The debtor admits that the cash book did not contain the whole of the receipts and the sold ledger was not properly kept. The Electro-Medical Co. are said to have kept cash book, bought and sold ledgers, petty cash book, day book and journal. The failure is ascribed to want of business experience.

Electrical and General Engineering Co., electrical engineers, 17, Gracechurch Street, E.C.—A receiving order was made on a creditor's petition on March 15th. First meeting, April 1st; public examination, April 28th; both at Carey Street, W.C.

Joseph Augustus Bauer (Electrical and General Engineering Co., as above), electrical engineer. Adjudication order made March 16th, on petition filed January 28th.

William Charles Ellis, electrician, Applegate Street, Leicester. —A receiving order was made on debtor's own petition on March 14th.

Alfred Horswill Gibbings, engineer, Liverpool. — First meeting, March 30th; public examination, April 11th; both at Liverpool.

T. A. Branion.—At a sitting of the London Bankruptcy Court held on Wednesday last week, before Mr. Registrar Giffard, the public examination took place of T. A. Branion, described as a purchasing agent. Bankrupt returned liabilities £1 999 against assets valued at £112. In the course of his evidence the debtor, who is an American citizen, stated that he came to this country in 1899, and had since been employed as material agent for a firm of electrical engineers and contractors. He resigned the post in consequence of these proceedings, and attributed his insolvency to extravagance in living His personal and household expenditure since February 8th, 1907, was returned at £3,638, against an income of £2,470 from salary, bonuses, and directors' fees. The balance of the present deficiency was chiefly accounted for by interest on loans £212 12s., and losses by betting £350. The examination was concluded.

LIGHTING and POWER NOTES.

Aldershot Camp.—In reply to inquiries in Parliament by Mr. Salter regarding the proposed extension of electricity supply from the Aldershot Camp generating station to the Camps at Deepcut, Blackdown and Ewshott, and as to why gas should not be used, the Secretary of State for War replied that it had been considered that it would be more economical to extend the War Department's installation, which would also provide a more satisfactory illuminant.

Alloa.—The Corporation is acquiring the full control of the electricity supply of the town. Satisfactory arrangements have been made with the British Electric Plant Co. As consulting engineer for the preparation of the necessary plans and overlooking the work, Mr. W. A. Ker, Glasgow, has agreed to discharge the whole duties for an inclusive fee. The Council is to invite tenders for the machinery necessary for the new electricity station to be erected at the gas works.

Australia.—A scheme for electrically lighting 13 townships in the Blue Mountains is on foot, a contract having been signed between Messrs. Blakey & Sinclair, of Sydney, and the Blue Mountain Shire Council, for lighting at £4 10s per lamp. The scheme is to be extended to cover other districts under the Council. The contractors are putting down three suction gas generating stations, with transformer stations at intermediate towns, and will expend £15 000 for initial work. In addition to supplying 300 200-c.p. street lamps, domestic and power supply is to be undertaken.

Ballinamore.—Electric lighting has been introduced into Mohill, 30 public and a number of private lights having been installed.

Continental Notes.—Germany.—The city of Alfeld, in the Province of Hanover, with 65 localities in the districts of Alfeld, Cronau, Holzminden and Gandersheim have joined forces for the erection of a central station, at an estimated cost of £250,000.

The Works Committee of the Agricultural Union in the Göttingen administrative district, has decided on behalf of 50 communities in the district to obtain its electrical energy from the Göttingen municipal station, a decision which will involve considerable expenditure on motors, lines, &c.

Sweden.—The State Waterfalls Department has submitted its proposals regarding the erection of a power station at the Porjus Falls of the Lulea River. It is estimated that 37,000 H.P. can be generated, at a yearly cost of 385,000 kr., and 50,000 H.P. for 445,000 kr. Of the power produced the State Railways will be customers for 25 000 H.P., at a cost of 287,000 kr. Negotiations have also been opened with the Luossavara-Kirunavaara Co., who offer to take power at the rate of 35 kr. per KW., and guarantee a minimum requirement of 350,000 kr. per year.

Bavaria.—The question of utilising the available water-power in Bavaria in connection with the proposed electrical working of railways and the use of electricity in industrial works has been under consideration for several years past, but it has not made any substantial progress. Now, however, a study company for water-power has been formed by the firms of the Augsburg-Nuremberg Machine Works, the Schuckert Electricity Co., Heilmann and Littmann and others with a share capital of £15,000. The company intends to occupy itself with the carrying out of water-power installations in agreement with the State authorities, private individuals, co-operative societies, and those interested in industry and agriculture.

Austria-Hungary.—The authorities of Patzau (Bohemia) have resolved to erect electrical works, and the municipal authorities of Agram have decided to enlarge the city electrical works by the addition of a 1,200-KW. steam turbine, new boilers, and accessories, &c., at a cost of (£17,500).—*Board of Trade Journal.*

Cuba.—Senor Antonio Larraz has been authorised to proceed with the installation of an electrical plant for lighting and power purposes at Bolondron, Province of Matanzas, as soon as he shall have obtained the requisite powers from the municipal authorities of Bolondron.—*Board of Trade Journal.*

Darlington.—A local paper, quoting official returns, puts the gross profit on the past year's working of the electricity undertaking at £7,141, and after making financial and reserve charges, £1,200 will be available for the relief of the rates. The electricity department has had a successful year, but the tramways department, will, it is expected, show an increased debit balance, compared with the previous year.

Falkirk.—The Corporation has appointed Mr. W. W. Lackie, chief electrical engineer to the Glasgow Corporation, to be advisory engineer in connection with the extension of the electric undertaking. The salary will be approximately 1 per cent. of the total cost. The work will be carried through by Mr. J. McMillan, the Council's electrical engineer, under Mr. Lackie's instructions.

India.—In regard to a concession for the supply of electrical energy or gas within the town of Lucknow for house and street lighting and other purposes, the Commercial Intelligence Branch of the B. of T. is now informed that it has been decided that electricity shall be used. Detailed plans in this connection are in course of preparation.

At the recent meeting of the Mysore Gold Mining Co., in London, the chairman referring to electric power supply, said that as a set-off to the renewal of the lease by the Mysore Government, with an additional royalty of 2½ per cent., the company was going to obtain the full benefit this year of its arrangement with the Government for power supply from the Cauvery Falls. The capital on the Cauvery plant had now been practically paid off, and under the agreement the royalties would be enormously reduced, *i.e.*, from £24 per H.P. per annum to £10, a saving of £9,000 to the company, which would increase slightly during the next two years.

Littleborough.—It was announced at a meeting last week that tenders would shortly be invited by the U.D.C. for the electric lighting scheme.

London.—Stepney.—The Electricity Committee of the B.C. reports that arrangements have been made to take a further supply of energy in bulk from the Poplar Council upon somewhat similar terms to those previously given by that Council, the price to be 0·3d. per unit for all current supplied untransformed at the Eastern sub-station.

Southwark.—The B.C. has received the sanction of the L.C.C. to the raising of a loan of £2,030 for the provision of a new storage battery.

Merthyr Tydfil.—A B. of T. inquiry was held at Dowlais, on March 17th, into the application of the Merthyr Electric Traction and Lighting Co. for consent to light certain streets at Dowlais by means of overhead wires. Petitions signed by 227 persons were presented objecting to the use of overhead wires, on the ground that in congested streets they would be dangerous, unsightly and obstructive to traffic. It transpired that the Merthyr T.C. had consented to the scheme; Mr. Thomas Lloyd, electrical engineer at the Dowlais Works, said that their overhead system had had to be altered to an underground system, because the atmospheric conditions of Dowlais were very bad in regard to corrosion and oxidisation. It was pointed out, at the conclusion, that a good deal of the objections which had been raised had evidently been put forward from want of knowledge.

Norwich.—The T.C. last week discussed the position of the electricity undertaking, and it was agreed to apply to the L.G.B. for permission to raise a further £17,783 capital. It is understood that the addition of an exhaust steam turbine plant is under consideration

Smethwick.—The T.C. has decided to oppose the prov. order of the Birmingham and Midland Tramways, Ltd., transferring the E.L. order to the Shropshire, Worcestershire and Staffs. Electric Power Co.

Southend.—The T.C. has applied to the L.G.B. for a loan of £1,000 for the purchase of bracket fittings for street lighting by electricity.

Swinton and Pendlebury.—The U.D.C. is considering a proposal by the Lancs. Electric Power Co. for the extension of the mains to the Broad Oak Park district.

Watford.—An agreement has been entered into for the supply of electricity to Munden and Mansted's farm for a period of 20 years. A supply is also to be given to Messrs. Andre and Sleigh, Ltd., Bushey Hill Road, the Bushey Council having given its consent. The charge for public lighting is fixed at £4,174 for the year ending March 31st, 1911. It was explained that the charge was stationary, although during the past two years the total candle-power in the streets had been increased from 27,000 to 40,000. One hundred posts are to be converted to metallic-filament lamps, and £20 is to be spent in advertising literature.

Worcester.—As the result of successful experiments carried out on the Bath and London Roads, the electricity department is to take over an additional 44 gas lamps on the tramway routes at £128, as compared with £122 now paid.

TRAMWAY and RAILWAY NOTES.

Aberdeen.—The Corporation Tramways Committee has agreed to have the track in Great Northern Road relaid at a cost of £9,575. The tramway poles are to be placed at the side of the thoroughfare instead of in the centre, as at present, at a cost of £1,650.

Birmingham.—Quinton, which is now a part of the city, is keenly desirous of having a tramway connection, and a petition to this end is being signed for presentation to the April meeting of the City Council. The petition sets forth that when previous applications for tramways were considered Quinton was outside the city boundary, and that the opposition to tramways to Harborne has often been of a mistaken and self-interested character.

Canada.—A Canadian correspondent says it is confidently expected that the mono-rail principle will be used for the new railway line from Ottawa to Kingston. An experimental track is now in use at the inventor's place near Montreal.

Continental Notes.—Germany.—Steps towards obtaining a concession for the construction of an electric railway from Kreuchnach to Sprendligen have been taken by the T.C. of the first-named city. The line will be 13·8 km. long, and is estimated to cost 900,000 M. A State subsidy of 13 000 M. per kilometre for the portion passing over Hessian territory is promised.

The Siemens-Schuckertwerke have drafted plans for an electric railway, 12 km. long, from Hohenstein to Lujau, Saxony. The cost is estimated at 1,500,000 M.

It is proposed to extend the Berlin Underground Railway from the Reichs-Kanzlerplatz, in Charlottenburg, to the racecourse in the Spandauer Forest.

The authorities at Altona, in Holstein, have decided to construct an electric railway to Eidelstedt, *via* Stellingen-Langenfelde.

Plans are being prepared in respect of a projected electric tramway between Reutlingen and Pullingen, Wurtemburg.

Switzerland.—The Italian branch of the Siemens-Schuckert Co. has applied to the Swiss Government for the concession to construct and work a narrow-gauge electric railway between Tirano and Bormio, in the south of Switzerland.

Dunfermline.—As a result of a conference between the Tramways Committee and Mr. G. Balfour, managing director of the Dunfermline and District Tramway Co., it is believed that the objections of the T.C., in connection with the company's prov. order for the extension of the tramways to Rosyth, will be withdrawn.

Hastings.—At Friday's meeting of the Corporation the defective state of the tramway track in various parts of the borough was strongly criticised. According to a report from the Roads Committee, the attention of the Tramway Co. has constantly been called to the defects, without the desired result. It was declared that in several places the track was very dangerous, and that the track on the Front was a scandal. It was also hinted that the object of the company was to get overhead wires along the Front in lieu of the existing expensive system. The deputy mayor (Mr. Harden) appealed to the Council to stand no more nonsense. Alderman Weston defended the company, who he thought were attending to the work as fast as possible. The upshot of the discussion was a decision to serve formal notice on the company to repair the whole of the portions of the roadways under their control, and that in the event of their failing to comply, the borough engineer be directed to execute the necessary work, after service of the prescribed seven days' notice, at the expense of the company.

Rawtenstall.—A conference of representatives of Rawtenstall, Haslingden and Accrington Corporations was held on Wednesday last week, and as a result there will be through running between Bacup and Accrington at an early date. The only point in dispute was the question whether the price of electricity used on the tramways should be 1½d. per unit or 1¼d. Rawtenstall contended for 1½d., on the ground that it could not see its way to agree to a known loss, for, as a matter of fact, the electricity will cost that amount. Accrington and Haslingden went in for 1¼d., but Haslingden afterwards agreed to 1⅜d., and to this figure Rawtenstall has now agreed. It is believed there will be a substantial increase of traffic, and the loss in the price of energy will be recouped.

TELEGRAPH and TELEPHONE NOTES.

Underground Telegraphs.—The Hull Chamber of Commerce has learned that the Postmaster-General has arranged in this year's estimates to continue the underground telegraph cable from Leeds to Hull.

Wireless Telegraphy.—A proposal is under consideration for the erection of a wireless station at Belfast Harbour, to communicate with the cross-channel steamers, many of which are fitted with wireless apparatus.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—April 9th. Generating station building, plant, battery, cables, &c, for the U.D.C. See "Official Notices" March 18th.

Australia.—Tasmania.—Material for accumulator equipment, for the P.M.G. See "Official Notices" March 4th.

April 27th.—200 tubular iron or steel poles, for the P.M.G.'s Department in South Australia. Forms, &c., at the Commonwealth Office, London.

Bedford.—March 28th. One 750-kw. steam-driven single-phase alternator and exciter. See "Official Notices" March 18th.

Bolton.—March 31st. Materials and stores for the Electricity Department. See "Official Notices" March 11th.

Colwyn Bay.—April 9th. Stores for the U.D.C. Electricity Department. See "Official Notices" March 18th.

Edinburgh.—March 28th. Materials for the Electricity Department for one year. F. A. Newington, engineer, Dewar Place; deposit 10s.

Felixstowe and Walton.—Steel boiler drum, oil cart and set of switchgear and cable connections, for the U.D.C. See "Official Notices" March 4th.

Germany.—The municipal authorities of Bischofswerda are about to invite tenders for the establishment of a central electric station in the town, at an estimated cost of £12,500.

Govan.—The Burgh Electricity Department is inviting tenders for engine-room stores, oils, &c., cables and accesories, bitumen and joint box compound, meters, fuse boxes, wrought-iron tubes and fittings, arc lamp carbons, joint boxes, &c. J. A. Houston, Town Clerk.

Glasgow.—March 29th. Main cables, meters and arc lamp carbons for the Corporation. See "Official Notices" March 11th.

March 29th.—Materials for the Electricity Department for one year. W. W. Lackie, City Electrical Engineer.

Gloucester.—April 2nd. Electric lighting of the Shire Hall extensions. See "Official Notices" March 11th.

Hackney.—April 7th. Flame lamp carbons for the Electricity Department. See "Official Notices" March 18th.

Huddersfield.—March 31st. 1,000 single-phase A.C. meters for the Borough Electricity Department. See "Official Notices" March 18th.

Roumania.—The municipal authorities of Focshani have decided on the establishment of a central electric lighting station in the town, and tenders for the carrying out of the work are about to be invited.

Salford.—March 31st. Electric wiring of the Wellington Street Boys' Council School, Pendleton. See "Official Notices" March 11th.

Spain.—May 8th. The Spanish Ministry of Public Works, in Madrid, is inviting tenders for the construction and working of an electric tramway between the Rue Velasquez and the Rue de Diego de Lion.

April 12th.—Tenders will be received at the offices of the Canal de Isabella II at Madrid for the machinery required for the water supply works for the upper part of the Spanish capital, including:—23 pumps, two electric motors, one steam engine and generator, one switchboard, one bridge crane with accessories, and keys, tools and spares.

Wallasey.—April 18th. Stores, for the U.D.C. Electricity Department. See "Official Notices" March 18th.

Wolverhampton.—March 30th. One 2,000-kw. turbo-alternator and one 500-kw. mixed pressure turbo-alternator, for the Borough Electricity Department. See "Official Notices" March 18th.

CLOSED.

Acton.—The U.D.C. has accepted the tender of Messrs. J. Griffiths & Son, of Wednesbury, for the supply of steel tubing for a year.

Asylum Lighting Contract.—The Scottish National Imbecile Institution, at Larbert is introducing the electric light, the contractors being Messrs. J. E. Cuthbertson & Co., Falkirk. Current is to be supplied by the Scottish Central Electric Power Co., Ltd.

Bristol.—The T.C. has accepted the tender of the Bedminster, Easton, Kingswood and Parkfield Collieries, Ltd., for 12 months' supply of coal to the Avonbank Works, at an estimated cost of £10,051.

Croydon.—The Guardians have accepted the tender of Messrs. W. J. Bishop & Co., for the supply of electrical fittings.

Hastings.—The T.C. has accepted the quotation of Messrs. W. T. Glover & Co., Ltd., for the supply of triple-concentric cable.

London.—Battersea.—The contract for the supply of the whole of the compressors for the construction of the main sewer from Battersea to Deptford has been awarded by Messrs. Griffiths & Co., the main contractors, to Messrs. Reavell & Co., Ltd., of Ipswich. There are in all 24 compressors to be installed at the various shafts and these are to be electrically driven, some by single-phase motors through automatic clutches of Messrs. Reavell's construction, some by two-phase motors through gears, and some by continuous-current motors which are directly coupled to the crankshafts of the compressors.

Bermondsey.—The B.C. has accepted the following tenders for annual supplies:—

W. Geipel & Co.—Arc lamp carbons.
Morgan Crucible Co., Ltd.—Dynamo and motor brushes.
W. Lucy & Co., Ltd.—Meter boards, street frames and covers and joint boxes.
Sykes & Sugden, Ltd.—Joint boxes.
Cables and jointing material.—Western Electric Co., Ltd.; Callender's Cable and Construction Co., Ltd.; Siemens Bros. & Co., Ltd.; British Electrical Trade Supply and Bitumen Co.; Silico Bitumen Co., Ltd.
Conduits.— Sutton & Co.

Hampstead.—The Board of Guardians has accepted the tender of Mr. Eric Rivers Smith for electrician's work.

Padiham.—The Co-operative Society has accepted the tender of Messrs. W. Rothwell & Sons, of Great Harwood, for a complete scheme of telephone communication.

Plymouth.—The Electricity Committee recommends the acceptance of the following contracts:—

Messrs. Walter Scott, Ltd., for 100 tons of tram rails, joint and anchor plates, at £8 per ton, and fish-plates at £10 per ton; also for the steel-work in connection with the new turbine at the electricity works, at the price of £31 15s., plus 2s. 6d. per ton for painting.
Messrs. Ferranti, Ltd., for house meters.
The British Electric Transformer Co., for transformers, at an average price of £1 14s. 5½d.

Southend-on-Sea.—The T.C. has accepted the following tenders:—

E. & B. H. Davey, Southend.—Car-shed extensions, £1,225.
Electric Apparatus Co.—50 meters.
Ferranti, Ltd., Hollinwood, Oldham.—250 meters.
British Insulated and Helsby Cables, Ltd., Prescot.—300 single-pole fuse boxes, 3s. 6d. each.
Electrical Co., Ltd.—Prepayment meters and current limiters.
Railway and General Engineering Co., Ltd., Nottingham.—Insertion in tram rails of 100 renewable maganese-steel plates, 35s. each.
Callender's Cable and Construction Co., Ltd.—Copper cables.

Watford.—The U.D.C. has accepted the following tenders: W. T. Henley's Telegraph Works Co., Ltd., 12 months' supply of cables. W. Cory & Son and E. Foster & Co., 12 months' supply of coal. Babcock & Wilcox, Ltd., fitting new close pattern links for chain grate stokers, £66.

Warrington.—The B. of G. has accepted the tender of the Liverpool Economic Co. for electrical requisites for six months.

FORTHCOMING EVENTS.

Association of Engineers-in-Charge.—Saturday, March 26th. Annual dinner.

Institution of Electrical Engineers (Manchester Students' Section).—Tuesday, April 5th. At 7.30 p.m. At the Grand Hotel, Manchester. Supper and smoking concert.

Austria.—The report of the Kabelfabriks und Draht-industrie Gesellschaft, of Vienna, for the last financial year shows a net profit of 842,959 crowns, as compared with 832,987 crowns in the preceding 12 months. A dividend at the rate of 11 per cent. is again being declared.

NOTES.

Automatic Telephone Apparatus.—In a paper on "Modern Automatic Telephone Apparatus," presented by Mr. Lee W. Campbell at a meeting of the American Institute of Electrical Engineers last month, the author set forth the advantages of the automatic telephony over the manual system, and described in great detail the method of making connections.

There are three classes of switches which take part in making every connection between subscribers—namely, line switches, selector switches and connector switches. Every subscriber's line terminates in a line switch, which is held automatically in readiness to connect with a free selector switch, which receives the signals sent out by the calling device, and makes connection with the proper connector switch, which then completes the circuit to the called line. Each connector switch serves 100 lines, and makes connections corresponding to the last two digits in the number called. It is impossible for one such switch to handle all the calls for the 100 lines to which it has access, and therefore it is usual to provide 10 connector switches for each 100 lines.

Originally there was one selector switch for every line, but the line switch, which is a much cheaper device, makes it possible to reduce the number of selector switches to 18 for each 100 lines without in any way increasing the time required to make a call. The line switch is so arranged as to be always posed ready for connection to an idle selector, and the removal of the receiver makes the connection. As soon as a selector has been connected to a line, all other line switches served by that selector are automatically moved along to a position in readiness for connection to the next selector. In an exchange of less than 1,000 subscribers the selectors connect directly to the connectors. For instance, in calling 649, the line switch connects to the first idle selector when the receiver is taken off the hook, then the selector picks an idle connector in the 600 group and the connector completes the connection to 49. An exchange of 10,000 lines is handled by introducing a second selector switch, one group for each digit in the fourth or thousands' place. Then the first selector picks a second selector in the group corresponding to the fourth figure in the called number, and this one selects the connector in the usual way. In the same way, by adding groups of third selectors, the size of the exchange may be increased to 100,000 lines, and so on.

Experience showed that in large exchanges the number of first selectors was considerably greater than needed, and therefore further economy has been made by introducing a second line switch between the first line switch and the first selector, thus putting each group of 100 first selectors at the service of 2,000 or more lines.

One of the most important advantages of the automatic system is the great saving in wire, and as the system becomes larger and is spread over more territory, this advantage increases in importance. This saving in wire is accomplished by grouping the subscribers into districts and running the lines to a centrally located district station, where they are connected to the line switches and the connection banks of the connector switches. All of the selector switches are placed in the main central office, so that all long runs may be trunked and the wires used at the best load factor. Experience indicates that 23 wires between the district station and the main station are sufficient for 100 lines, including wires for supervision of the apparatus.

Mr. R. W. Pope stated that in the West there were a number of large cities equipped with the automatic system. The users, apparently, are very enthusiastic in its praise; especially are they pleased with the dispatch and the reliability of the service.

Over 250,000 subscribers in the United States are now using the author's apparatus. For exchanges with a less number of subscribers than 500, the automatic cannot compete with the manual system unless its desirable operating characteristics are taken into account to balance its extra cost.—*Electrical World.*

Electricity in Agriculture.—An interesting example of the employment of electricity in connection with agriculture, as a development of lighting and power supply undertaken by a tramway undertaking, is reported from the district of Hanover. It appears that the Hanover Tramways Co. possesses three generating stations, and has various tramways which have been extended from that city into the country districts to a maximum distance of 18 miles, and the supply of power is also effected to over 120 different localities, estates, factories and small industries. One of the lines extends to Hildesheim, and both agriculturists and country industries have availed themselves of the opportunity to obtain cheap light and power. In addition to passenger traffic the tramways are used for the transport of goods in specially constructed wagons which are provided with two sets of wheels, one set of which is used for the tramway track, and can be raised by about 1 ft. when the other set is required for use, the wagons being removed by horse haulage to the farms or other places for the collection of goods. In this way the commodities are loaded on the spot, and there is no reloading, and goods can be delivered from Hildesheim to Hanover in less than two hours, whereas two days are occupied on the average in effecting delivery between the two towns by railway transport. The most recent statistics show that the company had in 1909 3,639 customers, representing 43,900 glow lamps, 266 arc lamps and 2,709 motors of a total of 13,567 h.p., the price being 5½d. per kw.-hour for lighting and 2½d. for power purposes. The total length of high-pressure long-distance mains, irrespective of the number, was 167 miles. Among the applications in agricultural and allied branches are mentioned the use of motors for driving chaff-cutters, beet-cutting machinery, bruising mills, oil-cake breakers,

sack hoists, &c., whilst electricity is also said to be used in connection with sheep-shearing and the felling of trees; for operating butter moulders, milk separators and pumps in dairies, and for the driving of thrashing machinery. It is stated that satisfactory results have attended recent trials of electric ploughs, and it is hinted that a company is in process of formation by influential agriculturists for the promotion of the use of electricity in agriculture.

Carbide of Calcium.—The severe crisis in the carbide industry on the European Continent has now lasted for a period of two years, and has become so intense that, as was mentioned in a previous issue, various German and other works have been compelled to suspend production, whilst others are declared to be conducted at a loss. A solution of the problem is, however, thought to be possible by forming an international syndicate. Various works equipped themselves for the contest some time ago, and intended to continue the fight to the bitter end. But owing to the large losses, and perhaps also to the pressure of bank connections, these works have gradually assumed a more conciliatory tone, and it is said that secret negotiations in regard to a syndicate have been opened with the Italian producers. As the latter are believed to possess very large stocks which could eventually only be disposed of at a loss, it is considered that an understanding with the Italian works will be possible. Should this be arrived at, it would be regarded as representing the preliminary condition for an international syndicate, as the arrangements made a year ago between the German, French, Austrian, Swiss, and Scandinavian producers are already worked out in detail. A fresh understanding in regard to the existing overproduction would doubtless result in keeping a number of works closed, as the manufacture of ferro-silicon and ferro-chromium is unremunerative at present market prices, whilst the output of nitrogen does not yet appear to have reached the stage of large production on an advantageous scale. It is stated that in consequence of the depression in prices brought about by the general excessive output, the principal French company manufacturing carbide will be unable to pay any dividend for 1909.

Gold Refining.—The process most generally adopted for the refining of bullion is one invented by Dr. Wohlwill. The method aims at obtaining pure gold from an alloy of silver, gold and platinum. To this end a bath of gold chloride containing free hydrochloric acid is used, the object being to form an insoluble chloride of silver during the transfer of the nobler metal from anode to cathode. The process requires close attention, especially when ingots rich in silver are being refined, as the chloride of silver sticks very tenaciously to the anode, and has to be removed by hand. If this precaution is not taken, free chlorine gas is set free from the bath, unless the current density is considerably reduced. In the latter case expense goes up, due to smaller output and increased capital charges per unit weight of finished product. To overcome these difficulties, a novel use of pulsating currents has been introduced by the Norddeutsche Affinerie A.G. The best method is to connect a direct-current dynamo in series with an alternating current. As long as the voltage of the latter is lower than that of the former, the net result obtained by the above superposition is a direct pulsating current passing periodically through a maximum and a minimum. When, however, the voltage of the alternating current is greater than that of the direct, there is an actual periodical reversal of the effective current. The electrolytic effect is the same as if no alternating current were used, and the amount of gold deposition remains unchanged. It is possible, however, to increase the anodic current density very considerably without causing a liberation of free chlorine gas, and without removing the layer of silver chloride. As an example, it is mentioned that if raw gold containing 10 per cent. of silver is treated according to the original Wohlwill process, an anodic current density of not more than 750 amperes per sq. metre may be used, and in this case it is necessary to scratch the anode surface every 45 minutes. When superposing an alternating current of 10 per cent. higher voltage than the direct current, it is possible to maintain an anodic direct-current density of 1,250 amperes per sq. m., without the necessity of scraping. The method may be used on alloys containing a much higher silver content than is possible by the original method. By the old procedure 10 per cent. of the gold removed from the anode passes as a finely sub-divided dust into the slime, and has to be recovered by chemical means. The pulsating current, on the other hand, practically suspends this precipitation, the slimes being essentially composed of silver chloride. In the original process it is necessary to heat the bath in order to maintain a high-current density, but by the above simple modification, a far more rapid rate of deposition may be kept up, without the application of any external heat. Even in the latter case, however, a still higher current density may be used if the bath is heated to 60° C. It seems highly probable that the above device will gain a wide application. In any process involving high capital outlay, the chief improvements must always be directed towards increasing output.

German Shipping and Wireless Telegraphy.—Efforts are being made in shipping circles in Germany to secure the removal of certain regulations which are said to hamper the use of wireless telegraphy in connection with navigation. It is pointed out that the lightships on the coast are everywhere equipped with wireless apparatus, and that they could therefore be rendered of greater service to shipping, but the possibility of utilisation is very slight, as it is limited only to cases of necessity, whilst for the rest, the lightships are forbidden to communicate with vessels fitted with wireless installations. The prohibition in Germany is based upon a notice given by the Imperial Post Office on August 22nd, 1909, and is contained in an annotation. But the question seems to refer to an international regulation since foreign lightships act towards ships equipped with installations in the same way as the German lightships. In advocacy of the abolition of the regulation, it is submitted that it is just as important to prevent an accident as it is to call for help in the case of a disaster. It is consequently considered necessary for ships to be able to communicate with lightships in instances other than those of necessity. The shipowners claim that a steamer coming in from the sea should have the possibility when arriving within the range of the lightship of getting supplied with information concerning questions of navigation, as, for example, whether wrecks are drifting, whether storm warnings are on hand, whether alterations have taken place in the conditions of currents, &c. It is also considered essential that wireless telegraphy should supplement other signals, as those of submarine bells; and that announcements concerning the working of a home or foreign ship should be accepted by lightships and forwarded. In the case of a damaged and overdue steamer which is heavily re-insured, such a vessel may be passed by a wireless equipped ship, and the latter be asked to announce the circumstance as soon as possible; and in an instance of this kind it would be in the interest of all parties if such announcements were immediately transmitted further on. A further demand relates to the greater use of wireless telegraphy for giving warning of storms by the transmission from the meteorological observatories of weather forecasts to the ships having installations, and from these vessels the warnings could be also conveyed by the hoisting of corresponding signals for the benefit of small ships, which, it is suggested, should also be fitted with small receiving apparatus. On the other hand, it is complained that the introduction of wireless telegraphy is rendered extraordinarily difficult by the present testing regulations. The ability to receive and transmit 20 words per minute is demanded, but this speed can only be attained by professional operators, and is very difficult for practical navigators. If the question is one of international regulation, it is held that endeavours should be made to bring about an alteration. The permanent English stations which are called are more polite than the German stations; they reply at the same speed as the inquiry, whereas the German stations do not deviate from their 20 words per minute, thus leading to repetition of questions and misunderstandings, of which complaints are said to be specially made by foreign navies.

Electric Zinc Smelting.—The production of zinc in the electric furnace has been in operation since 1906, when the first experiments were conducted by the inventors of the process, Messrs. Côte & Pierron. The furnace then used consumed 100 H.P. It consisted of a cylindrical crucible 40 cm. diameter, and 45 cm. high, composed of magnesia brick, and held together by a metallic casing. The top of the furnace contained a charging hopper, and the electrodes were introduced vertically. The stationary lower electrode consisted of a carbon cylinder 20 cm. diameter, passing through the bottom of the furnace, and projecting 10 cm. into its interior. The upper electrode was suspended by a mechanical arrangement. Two tapping holes were provided, one directly at the bottom, and the other 15 cm. higher. From the top of the furnace a channel conducted the metallic vapours to a condenser. The charge contained 46 per cent. of zinc, with a silica gangue, and not more than 4 per cent. of limestone. This was crushed and mixed with iron and lime in the proportion of 30 : 13 : 5. Charging was done every quarter-hour, and tapping every hour. The current varied from 1,100 to 1,200 amperes at a pressure of 30 volts. The energy consumption was 68 KW.-hours. The zinc retained in the slag was 3 per cent. of the metal reduced as a maximum, and the weight of zinc powder condensed was 13·7 kg. per hour. The electrode loss in 36 hours was 7 kg. All the problems connected with this process have not yet been overcome. At present several furnaces are working, and both zinc white and ingot zinc are produced. The total cost of producing and shipping 6,912 kg. of zinc white and zinc was 2,631 fr., which sold for 3,200 fr. When zinc white alone is required, carbon replaces iron as the reducing agent, and a much better product is obtained.—*La Houille Blanche.*

A Fault in the Wrong Place.—The cable from the engine room to the Castle was some 250 yd. long; a 37/16 paper, lead and armoured twin, laid underground. About half-way was a T-connection to the gardeners' cottages. Unfortunately, sufficient care had not been taken in making this joint; either the day or the wireman had been "wet," for when the contractors came to make a test, some months after, they found a dead earth, which was easily located at the joint-box.

"Leave it alone," said the foreman, "it'll likely dry out." He was an optimist. Still, there was plenty of time before them, for it was a new building and a long-drawn-out job. Time passed; the contractors left the job and came back again six months later, and they tested the cable again. More dead-earth than ever, if that were possible. The optimistic foreman made remarks.

"Never mind," said the Head of the Firm. "I have a notion, and we'll say nothing about it just yet. Plenty of time." The "notion" made the foreman smile; his optimism was restored. The Head went back to the office and wrote the Consulting Engineers. He strongly advised a man-hole being built for the joint-box. As he expected, the Consultants did not see the necessity. The matter dropped. In the meantime the foreman had warned the Clerk of Works of the importance of keeping the steam roller (then in use for making the drive) from the neighbourhood of the joint-box. This had been placed just at the

junction of the drive and a side path. The C. of W. promised readily.

He kept his promise with disconcerting care. Months went on, till the time came for the contract to be taken over. The Consultants were coming down on the morrow; the steam roller had been nowhere near the fatal spot, and a last despairing test had shown that the earth was as dead as ever. Contractors in despair; optimism at a discount; desperate tactics necessary. The foreman held a whispered colloquy with the Head, another with the night watchman, and the rays of the setting sun fell on passing gold.

The scene is midnight. The watchman is making an extended round at the other side of the building. The steam roller stands O.P, not a dozen yards from the crucial spot. Enter four conspirators. Silently they creep to the roller, desperately they work—the watchman, peeping discreetly round the corner, pants in sympathy, for it's very hard work—and a few moments later they steal away, content.

The next scene was in the morning. The Consulting Engineer made his test. "H'm! something wrong here, Mr. Contractor."

"Dead earth," said the Head. "Well, I'm not surprised. You'll remember we asked you for a brick man-hole. Then we asked the Clerk of Works to see that no heavy weights or strains were put on the joint-box. And this very morning, what do we find? Why, the steam roller absolutely lying on it. Been there all night, so the watchman says. Of course, I called the Clerk's attention to it at once; I guessed there would be trouble. What's happened is obvious. The weight's cracked the compound and let in the wet—it's clayey ground. The cable's ruined. And to think we got infinity when we tried it last night. Well, it's no fault of ours, that's clear"!

"H'm! if that's the case, I suppose we shall have to allow it. Very serious matter, this. H'm! What do you think it will cost to replace the faulty section"?

"Well, Mr. Consultant, you know what paper cables are once the wet gets in. I should not be surprised if its crept back 80 to 90 yards on each side of the T, and that'll mean something like £100 to replace it."

"H'm! H'm! Very serious indeed. What do you think of it, Mr. Clerk"?

"I'm thinking," said the Clerk of Works, "that it's no sae verra serious after a'. I was muckle fashed the morn aboot it, but noo I ca' to mind that we shifted the side path whiles th' electricians were awa' last year, I'm thinking you'll maybe find your T-box under yon new flower bed."

And they did! And their estimate was quite right—it *did* cost something like £100 to replace the damaged cable. But it was the contractors that paid it!

The Magnetic Properties of Iron.—It is an interesting fact of both scientific and commercial importance that pure iron is not necessarily the best for use in electrical machinery where it is desired to keep down magnetic losses. The use of iron containing silicon, for example, has greatly improved transformer construction, and has almost given rise to a revolution. Other impurities also cause a considerable change in magnetic properties. Thus, arsenic and tin greatly reduce the hysteresis losses and increase the permeability. Iron alloys containing very small percentages of arsenic do not differ greatly from pure iron, but as the impurity increases in quantity, a remarkable change is brought about in the hysteresis loop. The area of the latter diminishes 40 per cent. for the addition of 3·56 per cent. of arsenic, and 60 per cent. for 3·86 of the impurity. A 2 per cent. tin alloy also causes a 60 per cent. shrinkage of the area of the hysteresis loop. In addition, the above alloys show an increase of electrical resistance with a consequent reduction of eddy losses. Should further investigation show ageing qualities comparable to those of silicon alloys, then iron-arsenic and iron-tin combinations will be worthy of attention for transformer working, in view of the low hysteresis and high permeability.—*E.M.I.*

Electricity in Country Districts.—A remarkable sign of the times in the west of Germany is the interest taken in the supply of electric light and power by the provincial Diet or local governing council for the Rhine province. The province apparently assists through the Landes Bank the construction of secondary railways and waterworks, and the question of also rendering aid in the establishment of central stations for supplying rural districts recently engaged the attention of the 50th session of the Diet held at Dusseldorf. It appears that five districts some time ago asked for financial support in connection with electric supply works, and the matter was referred to a committee for consideration. The committee has come to the conclusion that it is not the duty of the province to become the supply authority, and that in view of the great importance of the problem, a sum of £5,000,000 would be required for loans for the purpose in the course of a few years. On the other hand, the committee expressed the opinion that the province is prepared to facilitate action on the part of the districts as far as possible in regard to the use of the roads for the erection of mains, and in respect of the assistance of the Landes Bank in the financing of undertakings. After a lengthy discussion the Diet has adopted resolutions to this effect. During the deliberations it was mentioned that the operations of the Rhenish-Westphalian Electricity Works Co., in which local authorities hold one-fourth of the share capital, have resulted in other supply authorities being compelled to lower charges for the general benefit, and that the undertaking is an excellent example of the co-operation of private enterprise and local authorities.

Electro-medical Apparatus in Hospitals.—At the annual meeting of the Birmingham and Midland Hospital for Skin Diseases, held a few days ago, it was reported that the most gratifying results had been obtained in the Röntgen Ray and Finsen Light Department. The Committee earnestly appealed to the public of Birmingham and the Midlands for immediate monetary help to enable them to meet the increasing demand for these and other modern appliances. The electrical department had outgrown its present accommodation, and the Committee had decided to make the needed alterations to the hospital premises to provide the electrical and radium department with adequate and up-to-date accommodation. These alterations and improvements were making heavy demands upon the funds.

Calcium Carbide in Australia.—According to a paper read before the Faraday Society by Mr. E. K. Scott, there is a considerable demand for calcium carbide in Australia for working gas-pressure sprayers, the acetylene gas evolved from carbide, on which water drips, being employed to produce a high pressure in a cylinder containing the insecticide solution, paint, or other liquid to be sprayed. This idea might find many applications in the country. In another paper by the same author, read before the Australasian Association for the Advancement of Science, it is stated that the importation of carbide into Australia rose from 2,892 tons in 1905 to 8,747 tons in 1907, representing a value of £130,639. He estimated that calcium carbide could be made in Australia (Queensland) at a cost of £7 15s. per ton—about half that of the imported carbide.

Fatality.—A youth of 18, named John George Scott, who had been employed as a motor attendant at St. Hilda Colliery, South Shields, was found dead on the floor of the engine house on 17th inst., and according to the evidence given at the inquest on 19th inst., the cause of death was electrical. The switchbox, near the motor, was found open, and the keys were in the door. Scott had charge of the keys to prevent anyone interfering with the apparatus, but it was not part of his duty to interfere with or to open the switchbox; the voltage at the time was about 3,000. Dr. Shepherd said he had examined deceased, and found no signs of injury or disease. There were no external signs of injury. In his opinion death had resulted from electric shock.

Appointments Vacant.—The Calcutta Corporation is inviting applications for the post of superintendant of public lighting; salary, Rs. 500 per month or more, according to man. In an advertisement appearing in the *Daily Telegraph* on March 21st, where the duties are set out fully, it is stated that there are at present 9,000 incandescent gas lamps, but it is in contemplation to light some of the principal thoroughfares by electricity.

Electricity in Turkey.—*La Reforme*, of Smyrna, commenting on the report of the Belgian Consul in that town, published in the Electrical Review of February 18th, with reference to the development of electrical undertakings in Turkey, states that no mention is made in that report of the electric lighting works which have already been inaugurated in Ouchak, an important town and the centre of the carpet-making industry. The concessionaires are a British firm—Messrs. Warren, Beattie and Co., Ltd.—who have an agency at Smyrna. *La Reforme* further states that nothing has as yet been done as regards the lighting of Boudja, although a concession has been granted. As regards the concession for the electrical works at Smyrna, several applications have been made, of which, says our contemporary, that of Messrs. Warren, Beattie & Co. offers the best terms to the Government. This firm is also charged with the installation of electricity in the theatre to be erected on the land near the Palais da France, at present used by a circus.

Whilst quoting the above, we are glad to state that we have on several occasions noted with satisfaction the activities of this British firm in a district which must in the near future offer excellent opportunities for electrical development.

Depreciation and Purchase Terms.—A somewhat remarkable statement (in the absence of any special circumstances) seems to have been made by a Mr. Tuckett at the recent meeting of the Chelsea Electricity Supply Co., Ltd. He is reported as stating, in the course of drawing attention to the way in which the accounts were made up in respect of deducting the reserve and depreciation fund from the amount of capital expenditure, that in view of the possible future purchase of the company by the local authority, it was undesirable to give the arbitrator a handle to argue that the company recognised that the renewals and depreciation fund represented depreciation actually incurred. The chairman seems to have replied that the accounts were drawn up in the Board of Trade form.

Pumping Whiskey Electrically.—At Messrs. Buchanan & Co.'s premises in Holborn an electrically-driven pump has just been installed, and is put to a novel use. It is arranged to pump various whiskeys from barrels in the basement of the building to large vats on the top floor, so as to obtain certain blends of the spirit. A special suction is provided for adding the required quantity of water to give the liquor the proper density, and the pump is also arranged to discharge air into the vats in order to effect the blending. In view of the nature of the liquor, the inside of the pump is tinned, as also is the inside of the copper pipe which has been fitted for conveying the whiskey from the basement to the top floor. The pump, which is capable of dealing with no less than 130 gallons of whiskey per minute, is of Merryweather's well-known "Hatfield" pattern, and is driven from an electric motor by means of silent chain, the whole being mounted on bed-plate and forming a compact installation.

Dinners.—Nottingham Guild of Mechanical and Electrical Engineers.—This society held their 13th annual dinner on Friday, March 18th, at the Victoria Station Hotel, Nottingham; there were some 140 members and guests present. Mr. F. W. Davies (the city water engineer), president of the Guild, occupied the chair, and accompanying him were Lord Henry Bentink, M.P., Captain Morrison, M.P., the Mayor and Sheriff of Nottingham, and visitors from many parts of the country. A long and entertaining toast list and an admirable musical programme were gone through, and though there were some 20 speeches, they were distinctly entertaining. The toast of "The Secretary," Mr. Taylor, was received with great applause, and the President in his remarks thanked this gentleman for his great and untiring efforts that had contributed so greatly to make the Guild such a success.

The staff of the Croydon Corporation electricity works recently held their annual dinner, under the presidency of Mr. Alex. C. Cramb (borough electrical engineer), the guests including the Mayor (Major J. E. Fox) and Mr. J. Gray Scott (former chief of the undertaking). The chairman said that in 1903 they sold 1,131,000 units; last year the sale was over 6,000,000. In the same period the revenue had increased from £40,000 to £64,650. By reductions in the charges the consumers had been getting benefits averaging £10,000 a year, or a rate equivalent to 2¼d. in the £. In 1903 the profit was £4,654; last year £6,952. The reserve fund had now reached the maximum of £34,578. Many things formerly paid for out of capital were now charged to revenue, yet working costs had been reduced from 1·82d. to 1·11d.; and if they could bring it this year to something under 1d. it would represent in the eight years a reduction of about 48 per cent. It had, of course, to be remembered that coal cost them 4s. more per ton than was the case with London stations.

"Model Engineer" Laboratory.—Quite appropriately, having for 12 years served the needs of the amateur mechanician in the pages of the *Model Engineer*, Mr. Percival Marshall and his colleagues have now established a laboratory and school of mechanics, under the above title, for the use of their clients, where the latter may have their apparatus tested and new inventions tried, or may be taught the use of workshop tools and scientific apparatus. A booklet has recently been issued, detailing the qualifications of the staff and the courses of instruction, with numerous photographic illustrations. It is a curious thing, this "fairyland" of engineering, so to speak, where infinite pains are spent on the production, perfect in detail, of diminutive copies of locomotives, yachts, aeroplanes, &c., where men who are engineers only in their spare time bestow unlimited labour upon what may be regarded as trifles. We have no doubt, however, that an immense amount of good is done by model-making; if it does not make men engineers, it makes them think, and may lead to many a useful invention being worked out and brought to a successful issue. We wish the "Model Engineer" Laboratory, therefore, good luck, and hope that its clients may all be model engineers indeed.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

General.—On Friday, March 18th, Mr. C. W. N. Dew, senior supervisor at the generating station, H.M. Dockyard, Devonport, was the recipient of a valuable chiming clock to mark the occasion of his recent marriage. The presentation was made by Mr. P. J. Watts, chief assistant engineer, on behalf of the subscribers, who consisted of the staff of the generating and substations.

Mr. A. Apps, who commenced business in 1865 in the Strand, W.C., is now about to retire, being over 70 years of age.

Obituary.—Prof. A. E. Dolbear died at Tufts College, Medford, Mass., U.S.A., on February 23rd, at the age of 74 years. Our American namesake says that the deceased gentleman was probably celebrated for his work in telephony and telegraphy more than any other single man, and "always claimed that he was the original discoverer of the telephone." "Excepting Edison, he initiated a greater number of electrical discoveries and inventions than any other man." Unfortunately, not being gifted with a keen commercial sense, he did not profit so well financially from his inventions as he should have done. Prof. Dolbear started life in the midst of difficulties; both parents died before he was 10 years of age, and he early sought employment on a farm. At 18 he became master of a small school, but later he found that it was necessary to secure a better education for himself, and so in the course of years, step by step, he rose until he occupied a unique position in the scientific world.

Mr. John Lancaster, manager of the Blackpool Corporation Tramways, died at his residence at Blackpool on the 18th inst. It is understood that he was the first manager of an electric tramway in the country, and had been manager at Blackpool since 1885, when the system was opened there. Prior to that he was at Darwen, connected with the steam tramway. He was 67 years of age, and was a native of Liverpool.

VALUE FOR MONEY IN MANUFACTURED PRODUCTS.

If it be proposed to purchase a machine or appliance to suit certain conditions, there is always one particular design which will carry out the purpose in view more economically than any other pattern, manufacturers of inefficient apparatus being only enabled to sell their goods, owing to the ignorance prevalent amongst the majority of buyers.

Suitability is, or should be, based upon the working and maintenance cost, together with due allowance for reliability, this latter factor being often of more importance than would appear at first sight, as it is foolish to economise in first cost and upkeep if there be risk of breakdown, which may result in the temporary idleness of men and machinery.

Electrical apparatus, embodying coils of insulated wire, is perhaps more subject to hidden defects than any other type of manufactured product, hence reliability is particularly sought for in dynamos, motors, transformers and such like machines or appliances.

Value for money is synonymous with the "suitability" described above, and the most successful manufacturers are those who continually improve their products so as to give better value than their rivals.

This policy entails a careful study of the conditions under which the product has to work, and a continual effort towards familiarity with the manufactures of rival firms. Sometimes it may be practicable to make one line of machines or appliances to suit average conditions; in other cases, two or more different designs will be needed to meet equivalent variations in the requirements.

Good judgment and constant watchfulness are required to carry out such a policy, but the reward is certain and considerable in the long run, as, when confidence has once been inspired, by these means higher prices can be obtained than are being asked by other makers.

A good reputation based upon "value for money" is a permanent asset and must in no way be confused with the vogue for inferior products created by clever advertising and other means of a less direct nature. Advertising, including papers read before the leading technical institutions, will help forward the sale of any product; but whereas in the first case an extending market with increasing profits is obtained at a moderate annual cost, the sale of the inferior goods involves a greater outlay for publicity together with a reduction in price.

It is not intended to indicate that no machines or appliances excepting the best can be sold at a profit. Ignorance will always abound amongst purchasers, and it may be quite possible to sell an inferior article profitably, but the price will not be so high as obtained by more up-to-date manufacturers, whilst the cost of selling is greater.

It is essential, however, that the *relative* value of the two products be maintained, hence the continual improvement we have shown to be necessary with the most efficient type, must also be made in the inferior article. It is the failure to appreciate this necessity which leads so many firms to ruin. No one can stand still, the efforts needed to make and sell inferior products being practically equal to those exerted by the firms of highest repute.

THE LAW OF ARBITRATIONS.

Persons who enter into contracts sometimes agree that disputes shall be referred to arbitration. Instead of actually naming an arbitrator, they agree to accept the decision of some person nominated by the President of the Institution of Electrical Engineers, or to appoint as arbitrators persons who are members of some well-known society or institution. What is to happen supposing it turns out, after the persons nominated have made their award, that they do not possess the necessary qualifications? In a case which was

reported in a recent number of the *Law Times Reports* (Jungheim *v.* Fonkelmann, 1909, 101, L.T. 398), the plaintiffs entered into a contract with the defendant, which contained a term that any dispute arising thereunder should be referred to two arbitrators, who were to be members of one or other of certain associations. A dispute having arisen, each party appointed an arbitrator, and an award was duly made. Neither arbitrator was a member of one or other of the associations named in the contract, a fact which was not known to the plaintiffs until after the award was made. It was held that the award was invalid.

The real reason for this decision was that the parties never really agreed to the arbitrament of the persons who pretended to decide their case. The rule provided that "the arbitrators appointed shall be in all cases principals engaged in the corn trade as merchants, millers, factors, or brokers, and shall also be members of the London Corn Exchange, the Baltic, or the London Corn Trade Association, and residing in the United Kingdom. Mr. Justice Pickford made it plain that, if a man consents to refer his cause to arbitration, he is entitled to the decision of the person to whom he has agreed. In giving judgment, he said :—

> The rule pointed out the qualification and description which any arbitrator appointed would have to fulfil. It was then said that, however that might be, there was here an agreement to refer to these two gentlemen *nomination*, and that therefore there was a submission to them, although they were not members. The parties were perfectly competent to consent to the jurisdiction of these two gentlemen, but the whole question was, Did they consent to do so? I do not think they did. They intended to appoint persons qualified under the contract, and not to make a submission outside the award. What was most strongly insisted upon was that the plaintiffs, having attended before the arbitrators, could not now object to their competence, and must be taken either to have waived any defect in qualification or to be estopped by their conduct from disputing it. I was not referred to any authority which seemed to throw any light on this particular question, nor have I been able to find any. I do find that all the cases on waiver proceed upon the principle that if a man knew of any disqualification or defect either in the arbitrator or the proceedings, and still continued to go on, he could not afterwards object. Every one of these cases proceeded upon knowledge, and I cannot find any case of a man waiving that of which he had no knowledge; and as I find that the plaintiffs had no knowledge, I cannot say that they waived it.

Applying this decision to the case of a contract between persons who have agreed to refer a matter to the decision of a member of the Institution of Electrical Engineers, it is clear that no award would be valid unless made by such a member. Where, however (as in the form of contract approved by that Institution), the reference is to be to some person appointed by the President, he would be under no compulsion to appoint a member, or even an electrical engineer.

NEW COMPANIES REGISTERED.

Walker, Horrocks & Co., Ltd. (108,026).—This company was registered on March 9th, with a capital of £5,000 in £1 shares (3,500 preferred ordinary), to carry on the business of electricians, engineers, suppliers of electricity for light, heat, power and other purposes, &c., to acquire certain inventions relating to improvements in the generation, storage, and use of electric power for lighting and other purposes, and in dynamo-electric machines and internal combustion and other engines, and to adopt an agreement with C. B. Walker. The subscribers (with 1,250 preferred ordinary shares each) are:—T. Horrocks, Albert Chemical Works, Corbett Street, Bradford, Manchester, tar distiller; F. Horrocks, 9, Leng Road, Newton Heath, Manchester, electrical engineer. Private company; the number of directors is not to be less than two or more than five; the first are T. Horrocks, F. Horrocks and C. B. Walker (all permanent); no qualification required; remuneration as fixed by the company. Registered office, Cornwall Buildings, 45, Newhall Street, Birmingham.

Wright Electrical Sales Co., Ltd. (107,972).—This company was registered on March 7th, with a capital of £2,000 in £1 shares, to take over the business of an electrical engineer and dealer in electrical appliances carried on by H. J. Wright at 5, Upper Mill Hill, Leeds, as the "Wright Sales Co." The subscribers (with one share each) are:—H. J. Wright, 5, Upper Mill Hill, Leeds, electrical engineer; A. B. Hudson, 5, Upper Mill Hill, Leeds, electrical engineer. Private company. The number of directors is not to be less than two or more than five; the first are H. J. Wright and A. B. Hudson; qualification, £25. Registered by Jordan & Sons, Ltd., 116-117, Chancery Lane, W.C.

R. J. Rodd, Ltd. (107,936).—This company was registered on March 4th, with a capital of £1,000 in £1 shares, to carry on the business of electricians, mechanical engineers, producers of electricity, motive power and light, &c., and to enter into an assignment between R. J. Rodd and the company. The subscribers (with one share each) are:—R. J. Rodd, The Old House, Church Street, Walton-on-Thames, electrical engineer; Mrs. L. Rodd, The Old House, Church Street, Walton-on-Thames, electrical engineer. Private company. The number of directors is not to be less than two or more than five; the first are not named; qualification, 100 shares. Registered by Foss, Bilbrough & Co., 5, Fenchurch Street, E.C.

Maxim Lamp Works, Ltd. (108,013).—This company was registered on March 9th, with a capital of £8,000 in £1 shares, to take over the business carried on by the Receiver for the debenture-holders of the Maxim Electrical Co., Ltd., at Shernall Street, Walthamstow, and to carry on the business of electricians, mechanical and electrical engineers, &c. The subscribers (with one share each) are:—F. Taussig, 46, Stanwick Mansions, W. Kensington, electrical engineer; J. F. Poynter, 56, Shernall Street, Walthamstow, electrical engineer. Private company. The number of directors is not to be less than two or more than four; the first are F. Taussig and J. F. Poynter; qualification, £500; remuneration as fixed by the company. Registered office Maxim Works, Shernall Street, Walthamstow.

Fors Accumulator Foreign Patents, Ltd. (108,151).—This company was registered on March 15th, with a capital of £3,000 in £1 shares (952 preferred), to acquire certain patents granted to H. F. Joel, A.M.I.C.E., by certain foreign Governments for inventions relating to improvements in electrodes for secondary batteries, and benefits of all improvements thereupon by the said inventor for all countries except the United Kingdom, France and Australia, together with all shares agreed to be allotted to the said inventor by the Société Anonyme des Accumulateurs Fors (incorporated in France), and to carry on the business of electrical engineers, manufacturers of storage batteries, &c. The subscribers (with 100 shares each) are:—H. F. Joel, 110, Strand, W.C., consulting electrical engineer; J. Weir, 155, Fenchurch Street, E.C., engineer; R. F. Baker, 20, Old Park Ridings, Winchmore Hill, N., civil engineer; E. B. Pike, Northern Outfall, Beckton, E., analytical chemist. Private company. The number of directors is not to be less than three or more than five; the first are E. A. Barnett, J. Weir and H. F. Joel (managing director). Registered office, 110 Strand, W.C.

Dawlish Electric Light and Power Co., Ltd. (108,147).—This company was registered on March 15th, with a capital of £10,000 in £1 shares, with objects as indicated by the title. The subscribers (with one share each) are:—C. N. Loveley, M.D., Undercliffe, Dawlish; A. Hobson, Oak Park House, Dawlish, gentleman; D. Anderson, The Cliffs, Dawlish, gentleman; F. G. Avant, 26, Strand, Dawlish, auctioneer; J. A. Purvis, 6, Pennsylvania Park, Exeter, engineer; J. Shapter, 1, Strand, Dawlish, ironmonger; A. Bearne, The Holt, Dawlish, merchant. Minimum cash subscription 4,000 shares. The number of directors is not to be less than four or more than 10; the first are G. N. Loveley, M.D., A. Hobson, D. Anderson, F. G. Avant, J. Shapter and A. Bearne; qualification, £25; remuneration as fixed by the company. Registered office, Warren Cottage, The Warren, Starcross, Devon.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Escare & Denelle, Ltd.—Charge on leasehold premises at Westminster, dated February 22nd, 1910, to secure all moneys due or to become due from the company to the London, County and Westminster Bank, Ltd.

India-Rubber, Gutta-Percha and Telegraph Works, Ltd. (1,122c).—This company's annual return was filed on February 2nd, when all the ordinary and preference shares had been taken up out of a nominal capital of £812,000 in 50,000 ordinary and 12,500 pref. and 18,700 unissued shares of £10 each. £625,000 has been received. Mortgages and charges: £400,000.

London Sherardizing Co., Ltd. (89,533).—This company's annual return was filed on January 24th, when 16,750 shares had been taken up out of a nominal capital of £20,000 in £1 shares. £3,750 has been received, and £13,000 is considered as paid. Mortgages and charges: Nil.

Adelaide Development Co., Ltd. (64,393).—This company's annual return was filed on January 17th, when the entire capital of £42,500 in £10 shares had been taken up. £10 per share has been called up on 3,700 and £3 on 250 shares, resulting in the receipt of £37,750; £3,000 is considered as paid on 800 shares. Mortgages and charges: Nil.

Singapore Electric Tramways, Ltd. (84,088).—A memorandum of satisfaction to the extent of £3,900 on November 30th, 1909, and to the further extent of £1,300 on February 8th, 1910, of debentures dated November 30th, 1906, securing £350,000, has been filed.

Simms Magneto Co., Ltd. (95,109).—Particulars of £40,000 debentures created January 27th, 1910, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the amount of the present issue being £34,000. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

"Electrician" Printing and Publishing Co., Ltd. (26,898).—Debenture dated February 18th, 1910, to secure £1,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Coutts & Co., 449, Strand, W.C.

Electric Vehicle Co., Ltd. (83,846).—Particulars of £20,000 debentures created November 10th, 1909, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the amount of the present issue being £2,000. Property charged: The company's property, present and future including uncalled capital. No trustees.

Bright's Light and Power, Ltd. (58,290).—This company's annual return was filed on March 1st, when 100,000 ordinary shares had been taken up out of a nominal capital of £200,000 in £1 shares (100,000 preference). £1 per share has been called up on 66,667 shares, resulting in the receipt of £66,489 5s. £177 15s. remains in arrears. £33,333 is considered as paid on the remainder. Mortgages and charges: £16,000.

City of Ely Electric Light and Power Co., Ltd. (85,444).—This company's annual return was filed on January 27th, when 3,003 shares had been taken up out of a nominal capital of £5,000 in £1 shares. 2s. per share has been called up, resulting in the receipt of £360 6s. Mortgages and charges: Nil.

Westinghouse Cooper-Hewitt Co., Ltd. (89,947).—This company's annual return was filed on December 21st, when the entire capital of £10,000 in £1 shares had been taken up. 5s. per share has been called up, resulting in the receipt of £2,500. Mortgages and charges: Nil.

Westinghouse Metal-Filament Lamp Co., Ltd. (89,948).—This company's annual return, made up to December 20th, has been filed. The entire capital of £10,000 in £1 shares has been taken up. £7 has been received, and £9,993 is considered as paid. Mortgages and charges: Nil.

Tonyrefail and Gilfach Goch Electric Light Co., Ltd. (78,637).—Particulars of £1,500 debentures created December 6th, 1904, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the amount of the present issue being £150. Property charged: The company's property, present and future, including uncalled capital. No trustees.

Topsham Electricity Supply Co., Ltd. (80,826).—This company's annual return was filed on January 25th, 1910, when 500 preference and 928 ordinary shares had been taken up out of a nominal capital of £3,000 in £1 shares (1,000 preference). £1 per share has been called up, and £1,428 has been received. Mortgages and charges: £500 debentures.

Lamp Manufacturing Co., Ltd. (76,151).—This company's annual return was filed on February 28th, when 5,400 shares had been taken up out of a nominal capital of £10,000 in £1 shares. £5,400 has been received. Mortgages and charges: £2,500 debentures and £400 mortgage.

Whitchurch and Pangbourne Electric Supply Co., Ltd. (75,400).—This company's annual return was filed on February 16th, when 995 shares had been taken up out of a nominal capital of £10,000 in £5 shares. £5 per share has been called up, and £4,975 has been received. Mortgages and charges: Nil.

Central Electric Supply Co., Ltd. (53,080).—This company's annual return was filed on February 22nd, when the entire capital of £100,000 in £5 shares had been taken up and paid for in full. Mortgages and charges: £410,944 4 per cent. guaranteed debenture stock.

Filaments, Ltd. (104,108).—Particulars of £700 debentures created February 11th, 1910, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the amount of the present issue being £140. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Ackroyd & Best, Ltd. (54,600).—Issue on January 5th, of £3,400 debentures, part of a series of which particulars have already been filed.

Church Stretton Electric Supply Co., Ltd. (80,857).—Further charge on certain lands, hereditaments and premises dated February 25th, 1910, to secure £100. Holder: E. Bond, 43, Thurloe Square, W.

Electric Landaulet Co., Ltd. (72,890).—A memorandum of satisfaction in full on March 8th, 1910, of debenture dated June 2nd, 1909, securing £5,000, has been filed.

Consolidated Electric Works and Appliances, Ltd. (101,022).—Second mortgage debenture to "bearer" dated February 22nd, 1910, to secure £1,940, charged on the company's undertaking and property, present and future, including uncalled capital (subject to first mortgage debentures, securing £2,500).

Morley Electrical Engineering Co., Ltd. (52,358).—This company's annual return was filed on February 24th, when 1,524 shares had been taken up out of a nominal capital of £5,000 in £1 shares. £504 has been received, and £1,020 is considered as paid. Mortgages and charges: £3,000.

Direct United States Cable Co., Ltd. (11,597).—This company's annual return was filed on February 16th, when 60,710 shares had been taken up out of a nominal capital of £1,300,000 in £20 shares. £1,214,200 is considered as paid. Mortgages and charges: Nil.

Ferranti, Ltd. (83,718).—Trust-deed dated February 25th, 1910 (supplemental to trust-deeds dated February 24th, 1905, and June 18th, 1907, securing £125,000 debenture stock). Trustees: H. R. Boyce, Winchester House, Old Broad Street, E.C.; and W. Jones, manager of Parr's Bank, Manchester.

British Columbia Electric Railway Co., Ltd. (51,953).—Issue on February 22nd of £530,000 debentures, part of a series of which particulars have already been filed.

CITY NOTES.

Madras Electric Tramways (1904), Ltd.

The annual general meeting of this company was held on the 17th inst. at Dashwood House, Old Broad Street, E.C., Mr. Walter S. B. McLaren presiding.

The Chairman, in moving the adoption of the report (see Electrical Review, page 442), said that it showed a considerable advance on that of the previous year, the gross profit for the year being £11,994. Head office charges and debenture interest showed a reduction of £65, but there was an increase of £35 in the provision for debenture stock sinking fund. They had liquidated the costs of the issue of the last debenture stock, and the increase in capital, the sum of £309 having been debited against the profits. The whole of the improvements and renewals up to December 31st last had been liquidated, and the balance to the credit of the fund was £457. It was the intention of the board to augment that fund as liberally in the future as circumstances would permit. They had standing to the balance of the debenture stock sinking fund £2,388, and had also set aside £3,000 for depreciation on plant, machinery, &c. After debiting interest, London office expenses, provision for the debenture stock sinking fund, and transferring the £3,000 just referred to, they had a net profit of £4,003. The payment of a 4½ per cent dividend on the preferred ordinary shares would absorb £2,517; a ¾ per cent. dividend on the preferred ordinary shares of the surplus profits of 1909 would take £431, and the payment of a dividend of 1 per cent. on the deferred ordinary shares would require £572. These dividends would absorb altogethrr £3,591, leaving £663 to be carried forward, and £40 would be carried to the balance of surplus profits for 1909 belonging to the preferred ordinary shares. It was gratifying to report that their traffic receipts also showed an improvement, although a less number of track miles had been run. They had carried 12,866,214 passengers, an increase of 5 per cent., although the number of actual miles run was reduced by 1·26 per cent. The average receipt per passenger was about the same. The company were proposing to make an extension of the tramways, and representations were being made to the Government for lowering their rental charges, in view of the extremely low fares which prevailed on the company's existing lines.

Mr. Thos. E. Ivens seconded the motion, and the report was adopted.

Windermere and District Electricity Supply Co., Ltd.

The directors' report for 1909 first mentions the loss by death of two directors, Messrs. Frank A. Roberts and John T. Logan. The gross revenue unfortunately shows a decrease of £580, which is almost entirely due to the increased use of metallic-filament lamps and the diminution in current consumed. This is unfortunate, for the time being, but may eventually result in a largely increased demand. The new turbine has been in use since April with most satisfactory results. The full effect, however, of the saving in coal consumption has not been felt during the year, owing to the fact that while the turbine was being installed, the coal consumption was much larger than usual, and in addition there was an inefficient supply of water during the first month or so after the new turbine was at work. There has, however, been a saving in the cost of coal of £216, as compared with the previous year, which to some extent compensates for the diminished revenue. The whole cost of the new turbine amounting to £301 has been charged against revenue, and the credit balance of the revenue account is £1,306, as compared with £1,910 at December 31st, 1908. A payment of 5 per cent. on account of arrears of interest has been received on the Keswick Electric Co.'s debentures, and from this source £94 has been credited to the net revenue account, and the arrears of interest due from the Keswick Co. on its debentures have been reduced by £377. The amount spent on capital account during the year has been £212, from which is deducted £87 for sale of free wiring installations, making a net increase to the capital expenditure of £125. Most of the money spent on capital account during the year has been for new mains and transformers. The disposable balance is £1,433; debenture interest, bankers' charges, &c., require £821. There has been transferred to depreciation reserve account £100; 2 per cent. for the year has been paid on the preference shares, and £12 is carried forward, leaving for disposal a balance of £261 19s. 3d. The transfer to reserve is considerably less than usual, owing to the large sum spent out of revenue on the provision of a new turbine.

Folkestone Electricity Supply Co., Ltd.—The number of 8 c.p. lamps supplied has increased from 103,990 to 111,748. Including the receipts from hired installations, the profit on the revenue accounts for the three undertakings amounts to £14,180 plus £328 brought forward. After allowing for interest on debenture stock, dividend on preference shares and bank charges, &c., there is a balance of £7,691. The directors have carried £4,300 to the depreciation fund, making it £4,855 net, £200 to reserve fund, making it £3,000, and have written off £100 from installation stores. They recommend a dividend at the rate of 7 per cent. per annum (less income-tax) for the half-year (making 5¼ per cent. for the year), leaving a balance of £341 to carry forward. The directors have during the year entered into an arrangement on satisfactory terms to the company, for the taking over of the consumers of Mr. C. Payer, who has for some years carried on business for the supply of electrical energy in competition with this company. It is intended to charge the purchase price paid over a period of three years, the first instalment having been charged in this year's accounts.

Scarborough Electric Supply Co., Ltd.—The annual meeting was held on 18th inst., Mr. G. Alderson-Smith presiding. The chairman said he regarded the report as fairly satisfactory. Speaking on the subject of depreciation, he said that he must endorse the contention of Mr. Armstrong, the Government auditor of the company's accounts, made in a speech at Newcastle, that they were not an ordinary trading company, that their position was in many ways identical with that of railway, gas, and water companies; that as quasi-Parliamentary companies electric supply companies must be classed, and on that basis must they consider the question of depreciation. Mr. A. A. Campbell Swinton, managing director, in seconding the report, said the outstanding points in it were that they were able to pay the same dividend as last year, to carry forward approximately the same sum, and at the same time put double the amount (£1,500, against £750) to the depreciation fund. The directors proposed experimentally to adopt the Norwich system of charging for energy on the same basis as water charges were made. They proposed to allow the consumers the alternative of paying (instead of 4d. or 5d. per unit, or whatever the charge might be per unit) 15 per cent. upon the rateable value of the premises, and in addition 1½d. per unit for the electricity used. The report and dividend were adopted.

Robey & Co., Ltd.—The directors report that the trading account shows a profit of £11,593. £8,969 is required for debenture interest, leaving, with £4,344 brought forward, a balance of £5,651, which it is proposed to carry forward. No deduction has been made for depreciation. The works and plant have been well maintained out of revenue.

Bukit Rajah Rubber Co.—A third interim dividend of 30 per cent., less tax, on account of the year ending March 31st is announced.

Gateshead and District Tramways Co.—The directors recommend a dividend of 6 per cent. and the transfer of £3,453 to depreciation and reserve account (making it £17,000), carrying forward £840.

Federated (Selangor) Rubber Co.—A third interim of 30 per cent., making 60 per cent. to date, on account of the year ended March 31st, is announced.

British Insulated and Helsby Cables, Ltd.—This company's annual meeting was held at Liverpool on Monday, Mr. E. K. Muspratt presiding. The report published in our last issue was adopted.

Hastings and District Electric Tramways Co, Ltd.

The annual general meeting of this company was held on the 15th inst., at the offices, 1, Queen Victoria Street, presided over by Mr. E. C. Morgan.

The Chairman, in moving the adoption of the report (see Electrical Review, page 397), said that last year he mentioned that the directors had in contemplation certain special measures, by which they hoped to effect considerable savings in the working expenses. The principal one was that which dealt with the cost of fuel, a very difficult question for their undertaking, as the cost of coal in Hastings was always high, by reason of its situation, which necessitated so long a land haul. He was glad to say that they had been able by the use of automatic stokers, to save nearly £500 under this head, and they might expect to improve upon this during the current year, as the stokers had only been in operation during the last six months of 1909. The saving thus effected had not been so much in the quantity of coal consumed, as in their ability to substitute for the extremely high priced Welsh coal, which they had been hitherto compelled to use in order to avoid smoke, a cheaper quality which the stokers had rendered smokeless. They had not, however, by any means confined their attention to the question of coal, but had strictly cut down expenditure wherever possible, with the result that economies had been effected in every department, which aggregated about £2,500. They also had it in contemplation when they met last year, to approach the municipality with the object of obtaining a revision of certain fares, which were established by an agreement between the original concessionnaire and the Corporation, but were obviously inadequate. As the result of their negotiations, some concessions were granted, but these were far short of what they sought, and, in their opinion, should have obtained to give them adequate return for services rendered. They were, however, compelled to take what they could get, as they had no means of enforcing what they asked. It was difficult to say what actual benefit they had derived from the concessions granted, as the difference of weather conditions in each year rendered an accurate comparison between the two years impossible, but they had derived some benefit, as was shown by the fact that whereas by reason of the more unfavourable weather this year decreases on all the lines had taken place, those upon the lines where the fares had been modified had been less than upon the rest of the system since the changes came into operation—during eight months of the year. The board had to report with regret that the receipts showed a diminution of £1,500. This they considered to be entirely attributable to the unfavourable character of the weather throughout the year, over which they unfortunately had no control. Their system was an exceedingly difficult one to work, as apart from the physical characteristics of the line, they were so largely dependent for their receipts upon pleasure traffic, which was dominated by the weather. It was not too much to say that the receipts in fine weather were to those of wet and stormy weather as 2 to 1, for not only did bad weather reduce the number of visitors, upon whom their pleasure traffic largely depended, but their carrying capacity was cut down by one half, inasmuch as their outside seats were practically empty during wind and rain. As it was necessary to maintain a regular service at all times, it would be recognised that it was impossible to reduce their outgoings proportionately under unfavourable conditions, so that whatever their receipts, their expenditure was to a large extent fixed. To sum up, it would be seen that although they had effected savings amounting to about £3,000, of which £500 was contributed by the directors, who had only drawn one half of the remuneration to which they were entitled by the articles, they were at once robbed of one half of this amount by the inclemency of the elements; and the surplus, after paying debenture and other interest, was little more than at the end of 1908. They had deemed it right to set aside for depreciation the sum of £8,000, thus increasing the amount available for that purpose to £12,000. It was obvious from this and the preceding accounts, that the anticipations formed at the inception of the company as to the earning capacity of the undertaking were exaggerated, and the directors were considering the desirability of formulating a scheme for the modification of the capital account. Meantime, they would continue to watch over the conduct of the business and exercise all their influence in keeping the expenditure within the lowest limits compatible with efficiency. Their expenditure per car-mile had been reduced from 6·11d. to 5·53d., a figure which compared very favourably with that attained by other tramway enterprises in this country, and they trusted that when the measures which they had taken to induce economy became fully operative, a further reduction might be shown. Mr. George Kitchen seconded the motion.

Mr. H. Leeds said he thought the £8,000 which it was proposed to put to reserve should be used for the payment of dividends.

The Chairman said they had good reason for putting it on one side.

Mr. Leeds: I think the shareholders ought to have a say in it.

The Chairman: Well, we are on the board, and as long as we are here it is necessary for us to do what we can for the safety of the undertaking.

A Shareholder remarked that he entirely agreed with the action of the board. He considered they should have a good reserve. He was glad to see the board were economising as far as was compatible with the maintenance of the line in a thorough state of efficiency, and the board were to be complimented on only taking half their remuneration. The payment of £150 to the trustees was an item that might be kept down.

The Chairman said that their remuneration was fixed by a trust deed.

The report was adopted.

The Chairman, in proposing a vote of thanks to the manager (Mr. Thos. A. Holliday) and the staff at Hastings, said they had every hope that the current year would show an improvement. During the first two months—January and February—the weather was atrociously bad, yet they were able to maintain their receipts at the same level. Since the commencement of this month they had shown an increase, and he had no doubt that if only they had fine weather, the company would show a decided improvement.

The resolution was carried.

Mr. Holliday, replying on behalf of the staff, remarked that nothing would be spared to bring about results which should be satisfactory, provided they had good weather.

Bournemouth and Poole Electricity Supply Co, Ltd.

Mr. A. H. Sanderson presided on Thursday of last week over the thirteenth annual meeting of this company, held at Moorgate Court, Moorgate Street, E.C.

In moving the adoption of the report (see Electrical Review, page 444), the Chairman said the share capital remained the same. Sundry creditors on open accounts and bills payable, amounted to £16,750, which were fully balanced by the sundry debtors on the other side. The leasehold and redemption fund stood at £11,338, and reserves for depreciation, &c., at £22,412. The total capital expenditure up to December 31st last amounted to £443,200, of which £10,701 had been expended during the year. That sum was a reduction on the amount spent in 1908, which was £11,300. As in previous years, by far the largest proportion of the sum was spent on extension of mains—no less than £8,230 having been expended under that heading. This expenditure was, of course, unavoidable each year, as their area of supply was a very extensive one. With regard to the investments in the Richmond Co., he should mention that £7,500 had been advanced to them on loan during the past year. The sundry debtors and suspense account stood at £25,399, which largely consisted of consumers' accounts outstanding at Christmas, but most of them had since been paid in. As to the revenue account, the sale of current and meter rentals showed an increase of £464. The trading accounts were £237 less, but that was principally accounted for by charges which were not likely to occur again. There was an increase in the sums received from interest on dividends due to the improvement shown by the Richmond Co. On the debit side of the accounts they had a very satisfactory decrease of £860 to the items of coal costs, &c., equal to 5·8 per cent. in the total costs of generating and distributing. They anticipated that there would be a reduction in the costs as a result of the reconstruction in the boiler house. The other expenses all stood about the same, with the exception of advertising, which showed an increase due to the efforts they had made as a set-off against the introduction of the metallic-filament lamp. Referring to the increase of £464 in the receipts for current and meter rentals, the chairman said that the falling off in the increase as compared with previous years was undoubtedly due to the metallic-filament lamp, by means of which consumers were able to get more light at less cost than formerly. They could console themselves by the charitable reflection that in the case of the metallic-filament lamp the company's loss was the consumers' gain. He thought that the lamp had been more rapidly adopted at Bournemouth than in other parts. The town was essentially a residential one, and there were no large businesses which demanded a power load. The hotel proprietors had also seen the new lamps' advantages. He ventured to think that the present year would see an end of the temporary difficulties, and henceforth they would experience their accustomed prosperity. The metallic-filament lamp had had an even greater effect on their revenue than they had anticipated, and in order to safeguard the shareholders' interests the board increased the standard rate of charge for lighting by a ½d. per unit. That took effect on July 1st, but it was impossible to state exactly what its effect had been; the board had every reason to think that their action was a right one, and that it would be beneficial to the company. He might say that the officials had told him that they could not trace any customer having been lost by the introduction of the new rate. As to the progress of the company's business, they had an increase equivalent to 16,971 30-watt lamps, the total connected to the mains at December 31st last being equal to 223,156 30-watt lamps. They had had 482 new consumers, making in all 5,869 consumers connected to the company's mains. Since the accounts were closed they had added an equivalent of 3,023 30-watt lamps up to March 15th, an increase of 349, or equal to 10 per cent. over the corresponding period of last year. They had 795 miles of mains. The Richmond Co., in which they were interested, had had a successful year, and that satisfactory state of affairs was reflected in their accounts. He trusted that the ordinary shareholders would not suffer much disappointment at their slightly reduced dividend. They were tackling the problem of how to meet the introduction of the metallic-filament lamps which were making inroads on their revenue, and he hoped it would not be long before they returned to their dividend of 6 per cent. on the ordinary shares. Although the cloud had overshadowed them, he believed there was a silver lining; he hoped and expected that the cloud would soon pass away, and that they would again enjoy their accustomed prosperity.

Mr. T. A. Hosker seconded the motion, and the report was adopted.

Brompton and Kensington Electricity Supply Co., Ltd.

Mr. H. R. Beeton presided on the 16th inst. at Winchester House, Old Broad Street, E.C., over the annual meeting of the above company.

In moving the adoption of the report (see Electrical Review, page 443), the Chairman said that during the past year the company had continued to be adversely affected, though in a less degree, by the metallic-filament lamp. The progress of the business, which was set out in the table in the third paragraph of the report, showed that the gross revenue in 1909 declined to the extent of £2,300, and this notwithstanding the satisfactory increase of £10,976 in "lamps" connected and 290 in customers; or, stated in another way, notwithstanding an increase of over 6 per cent. in customers and over 5 per cent. in "lamps" connected, the gross receipts had declined approximately 4 per cent. This result, though mainly due to the continued substitution of the higher efficiency lamps, had been aggravated by brighter weather. They seemed to be losing the fogs and to be enjoying more winter sunshine, thus reducing the demand for artificial light in day-time. The loss of revenue entailed by the substitution of new lamps for old was mitigated, as was anticipated, by the adoption of a higher standard of illumination and by the more rapid displacement of gas, but it might be some little time yet before the gain overtook the loss which this development entailed. Their system of alternating-current supply at 100 volts, which was peculiarly applicable to the use of the low candle-power metallic-filament lamps so far available, and which was worth more to the consumer than any other form of supply in consequence, had exposed them to the brunt of the innovation, and had imposed upon them, before most others, the obligation of meeting the changed condition of things. The policy which they had laid down for themselves in these circumstances had been, in the first place, to take advantage of the higher efficiency lamps to encourage a higher standard of illumination and the further displacement of gas, by continuing to give a supply at the former rate per unit; and, in the second place, to stimulate the demand for electricity for heating and cooking by placing the latest appliances for such purposes at the disposal of their customers in conjunction with a combined tariff for heating as well as lighting, which enabled them to avail themselves of electricity for all purposes at a low average rate. They offered their customers, without their having to incur the expense of a separate wiring system or a separate meter, a supply of which they could avail themselves for lighting, heating, cooking, and motive-power purposes on a basis of a tariff which, without increasing the cost of their lighting, gave them the additional electricity required for all purposes at 2d., and beyond a certain quantity at 1d. per unit. In process of time, when the system thus inaugurated was carried to its proper conclusion in conjunction with the installation of central water-heating, the kitchener, with its coal-cellar and dust-bin, would be superseded, and cooking would be done by turning on a switch. When that good time came, there would be no fires to lay or grates to clean up, cooking utensils would not be soiled by smoke, and as all dust would be removed by electrical vacuum-cleaners, the expense and hardship of domestic service would be materially reduced, to the mutual advantage of the public and themselves. The old methods were, however, slow to change, and, owing to limited use and restricted demand, the supply of appliances was not at present as cheap and efficient as it would be. In the meantime, there were indications that their customers were beginning to appreciate the facilities they were offering them for maintaining, if not increasing, their consumption of current, and they hoped by this means to obviate any necessity for raising the charge in order to protect their revenue. He trusted that with these observations, and especially after a visit to their new offices and showrooms at 254, Earl's Court Road, the shareholders would be satisfied that they were doing everything possible to meet and counteract a further reduction of revenue, and he was sure they would realise that they were now reaping the benefit of the policy of liberal reserves which they had sanctioned for so long. Having dealt thus fully with the position and prospects of the revenue, he turned to the expenditure, which called for little comment. It was regrettable that with a revenue which was no larger to-day than it was six years ago, the expenditure should be £2,200 greater than at that time, but this was almost entirely attributable to the growth of rates and taxes in the interval. It was a significant fact that the local authority, which, in the present state of the law, they had no voice in controlling, exacted, without the investment of a penny, a tax equivalent to nearly 25 per cent. of their dividend, and obliged them to charge the public 10 per cent. more for current than they would otherwise have to pay. The chief reduction in their expenditure during the year under review was due to the exceptional repairs and Parliamentary expenses in 1908, and in the aggregate they had managed to save £1,608, whereby their net revenue for the past year had only been reduced by £713. Their net revenue for 1909 amounted accordingly to £27,080, which, with £9,399 brought forward, and £622 balance of interest account, made a total of £37,103 available for distribution. Out of this amount they proposed to make the following appropriations:—First, £3,604 to depreciation, which, after providing £2,309 for demolition, raised this fund to £80,000—at which figure they proposed that it should stand for the present; then, £6,000 to reserve, raising this fund to £16,000; then the amount requisite to pay the usual dividends of 7 per cent. on the preference, and of 10 per cent. on the ordinary shares; and then, after applying £409 by way of additional remuneration to the directors under the articles, to carry forward a balance of £8,521. During the year they had practically completed the erection of the new switchboard which was of sufficient capacity to meet all requirements for many years to come with an increased measure of safety, and which was, accordingly, a valuable acquisition to their undertaking. The cost of this improvement and of certain incidental alterations to station cables was mainly responsible, under the several headings, for the capital expenditure of £3,462, and for the charge of £2,309 to depreciation which appeared in the accounts. The cost of the new offices and showroom, which, not being part of their statutory undertaking, were not included in the capital account, appeared as an asset of £1,443 in the general balance-sheet. This was, of course, one which would not recur, and which would be speedily written down to a safe point out of profits, and would prove of the utmost advantage to the business.

Mr. W. R. Davies seconded the motion.

Mr. Cross asked what the £19,910 investments consisted of, as they did not seem to bear a great rate of interest.

The Chairman read the list of investments, and pointed out that £6,000 was only invested during the year, and therefore they had only received half a year's dividend.

Answering a further question by the same shareholder, the Chairman said the board wished to interest their shareholders in their showrooms, where they would find appliances properly fitted up. If consumers desired to continue a flat rate of lighting they could have a separate circuit and meter at a low rate for heating and cooking purposes, but the policy he had referred to was a policy for a uniform tariff for both heating and lighting. They were prepared to offer any customer the alternative of a uniform tariff, which, without increasing his light bill, would give all the additional units he wanted at 2d., and, after a time, for 1d. They had already made a considerable number of contracts.

The motion was carried and the chairman was re-elected a director.

Victoria Falls Debentures.

The principal German banks have just offered for subscription, as already reported in this journal, £900,000 in 5 per cent. "B" debentures in the Victoria Falls and Transvaal Power Co. In discussing the issue, which is the second of its kind in Germany, where £800,000 "A" debentures were disposed of in 1908, the *Berliner Tageblatt* states that the total assets in the balance-sheet on December 31st, 1908, amounted to £2,824,554, although it cannot be exactly ascertained from the explanations accompanying the balance-sheet, what is real estate and what is not. Notwithstanding the explanations the making up of the balance-sheet is not regarded as sufficiently transparent. Despite the large sums which obviously come into consideration in the matter, the principles and the amounts at which in particular the concessions and the so-called good-will are valued are not discernible, and it must in some measure produce surprise that the admission department of the Berlin Stock Exchange could pass the balance-sheet in this form. It is also strange that the emission was not postponed until the period when the balance-sheet for 1909 was available. The surpluses obtained by the company amounted to £49,500 in 1907, £64,200 in 1908, and £63,600 in 1909. After deducting the sums requisite for the interest on loans, the company's net profits were £36,700 in 1907, and £48,200 in 1908, making a total of £84,900, which was carried forward to 1909. No statements are made as to the net profits in 1909, and a sufficiently detailed account is not available for the year 1908. It must not be forgotten that the requirements for interest on the new loan in the following years amounts to £45,000. The net profits for 1908 only slightly exceeded this sum, but it must be taken into consideration that the large new installations, the employment of which is assured to a certain extent by contracts of long duration, will first co-operate in future years.

Milford-on-Sea Electric Light Co., Ltd.—The directors, in their report for 1909, state that the progress during the year has been satisfactory, the revenue showing an increase from £742 to £765. On the other hand, the expenses appear to have increased by the sum of £168. This increase, however, is more apparent than real, and is accounted for to a considerable extent by an alteration of the accounts, in compliance with the requirements of the Board of Trade. After providing £74 for depreciation and paying the full interest on the 4 per cent. debentures, there remained a balance of £219 to the credit of the net revenue account, out of which the directors recommended the payment of a dividend of 4 per cent. on the ordinary shares, the balance being carried forward. The directors, in view of the heavy expenses against the year's working, have decided to suspend their fees for the past year. The number of lamps show an increase of 200, and the amount of current consumed an increased 1,743 units.

The Schuckert Co.—A greater amount of interest has recently been manifested on the Berlin Stock Exchange in the shares of the Elektrizitäts Gesellschaft vorm. Schuckert & Co., of Nuremberg. In the absence of other explanations, exchange circles attribute the circumstance in the first place to the fact that as the company's bank debt has disappeared and been replaced by a bank credit, the company has regained an increased capability of action from the improvement in its general position. This has rendered it possible for attention to be again devoted to undertakings in connection with which the company can financially co-operate. Various schemes of the kind, such as, for instance, overland central stations, are said to be pending.

City of London Electric Lighting Co., Ltd.

THE ordinary general meeting of the above company was held on the 16th inst. at Salisbury House, E.C., under the chairmanship of Mr. J. B. Braithwaite.

In moving the adoption of the report (see ELECTRICAL REVIEW, page 398), the CHAIRMAN said there was no change in their capital account. They had made no issue of capital since 1901, and during that time they had laid out on capital account about £232,000, the whole of which had been provided out of revenue. The capital expenditure for the past year had been somewhat larger than they had been accustomed to of late years. It had been £58,940, compared with £44,709 in 1908. They had paid for a large new unit of generating plant, and the first portion of the large economiser had been erected, and they had put up new offices on the Bankside frontage. During the present year their capital expenditure would also be considerable. They were going to complete the new offices, and proposed erecting the second portion of the economiser, and a commencement would be made in replacing the old alternating-current plant by steam turbines of the Parsons type. They had two such engines on order for delivery this year. The capital expenditure on works demolished was £21,502, as compared with £32,461 in 1908. He had explained on previous occasions that when they substituted new plant for old they wrote off the entire value of the old plant out of their books, so that they kept their plant thoroughly up-to-date, and carried forward no arrears of old and obsolete plant. With regard to the revenue account, they had had an increase in their gross revenue of £4,922. In view of the increasing use of the metallic-filament lamp, that result could only be regarded as very satisfactory. In the City especially, he would say that a very large number of their customers had adopted the new lamp, resulting in a large economy in the consumption of current for them, and it might have been expected to result in a considerable diminution of their revenue—at any rate, temporarily. He had told them before that, in his opinion, the metallic-filament lamp would be of great benefit to the electric industry generally; but he confessed that with so many consumers changing from carbon to metal-filament lamps he hardly expected that they would this year have had an actual increase in the gross revenue. The total gross revenue now stood at the substantial figure of £286,302, in addition to which, they had the fact of a further reduction in their working expenses and other charges of £2,347. These two items together brought about the net result of an increase in their profits of £7,269 for the year. The economies had been brought about in the following manner. In coal they had effected a reduction of £3,062, and although the greater part represented the difference in price, yet there was a balance due to reduced consumption, notwithstanding that 1,800,000 additional units had been generated. He did not know whether they would fully take in what that meant. It meant that their chief engineer, Mr. Bailey, had succeeded in generating 1,800,000 additional units for a smaller amount of coal than he used in the previous year. This was partly due to the economiser which they had erected. Other expenses had been reduced by £261, making the total reduction in expenses over which they had direct control £3,323. The items over which they had no control continued to show an increase. Rents, rates and taxes, as usual, showed an increase of £909, and management and other charges of £67, a total of £976, leaving a net reduction in their expenses of £2,347. The quinquennial valuation would be made this year, and he was afraid the result would be a further increase in the assessment of their undertaking. The result of the revenue account so far as the dividend position was concerned, was that they had an available balance of £104,926, as against £90,443 last year, an increase of £14,483. This increase was made up of £7,269 increased net profit; they brought forward £6,930 more than in the previous year, and their appropriations had been less by £284. They had given serious attention to the manner in which they should deal with the surplus, for they desired to act prudently and conservatively, and yet at the same time not withhold from the shareholders that which was rightly theirs. They had come to the conclusion that the time had arrived when they might safely raise the dividend from 6 per cent. to 7 per cent., and in order to make that step as secure as possible they had created a new fund—the dividend equalisation account—and had placed £10,000 to the credit of the fund. This would secure the extra 1 per cent. for a year and a-half, and in pursuing this line they were making it as secure as was humanly possible for the 7 per cent. dividend to be maintained. They still put away £45,000 out of revenue to their depreciation fund, so that whilst they distributed a dividend which took approximately £50,000, they were putting aside a sum equal to the dividend in order to strengthen the company's position. That was a sound policy, and one which he was sure would meet with their approval. In order to make up the £10,000 for the equalisation of dividend fund, they had drawn to the extent of £1,745 on the amount carried forward, but it still left them with over £20,000 to carry forward. These results had been obtained, in spite of the fact that the average price obtained for their current had shown a further reduction of nearly 2½ per cent. With regard to the increase in connections during the year, they had adopted a plan which was the only sound one, of recounting all their customers who had adopted the metallic-filament lamp, and reduced their demand in their books in accordance with the reduction which had taken place by the substitution of metallic-filament for carbon lamps. The result was that about 1,000 KW. had had to be deducted for metal-filament lamps alone. This was to say that the substitution of the metallic-filament lamp had reduced the demand on their station to the extent of 1,000 KW., or, say, roughly, 1,300 H.P. In spite of that fact, the additional business they had secured enabled them to make good the whole of that and put them 447 KW. to the good at the end of the year, which was also very satisfactory, in view of the limited area they served in the city. It showed that their officers were doing all they could to obtain new connections from the comparatively limited portion of the city which was still unlit by electricity, and as a consequence the increase in the number of customers was considerably greater than usual. Heating supplies had shown a greater increase than in any previous year. The chairman proceeded to deal with the question of the advantages to be obtained by having electric heating in the city, which he said were not realised by the public as they should be. Returning to the question of the economies which had been effected, he said that in 1899 the company sold 8½ million units, and to generate these they consumed 57,000 tons of coal. In 1909 they sold 26,318,000 units, and consumed 46,700 tons of coal. In other words, they had generated over three times the amount of energy for a given quantity of coal; or, rather, they burned 11,000 tons of coal less, and turned out three times more current. They had one engine at Bankside which generated nearly 4 million units last year at a cost for repairs and renewals of £20, and they had one dynamo which had turned out about the same number of units at a total cost for repairs of 17s. 8d. He was not saying that these were ordinary figures, but it gave an illustration of what was possible with modern plant and machinery—of course British made. With regard to the outlook for the current year, of course it was never wise to prophesy, and they were gradually cutting their own throats because, with the enormous number of lights and radiators, they were doing much to diminish the London fogs, and naturally they would suffer from that. At the same time their business was going on well, and so far the applications from new consumers were considerably more than in the corresponding period of last year, so that there was no indication that they had reached the limit of demand for electricity in the City of London at the present time.

MR. F. W. REYNOLDS seconded the motion.

MR. CRIPPS, who remarked that although he had been connected with many concerns in the City in the last 35 years, he had never attended a City meeting, asked if the board had taken into consideration whether it was possible for the electric lighting companies to amalgamate in the same way that so many of the gas companies had.

The CHAIRMAN, in reply, pointed out that the gas companies were in a very different position to the electric companies. The gas companies had an unlimited tenure, but all the London electric light companies had purchase clauses which rendered any general policy for amalgamation impossible at the present time.

The report was adopted, and the retiring directors re-elected.

Warrants in payment of the balance dividends for the year 1909 were posted on March 16th.

Direct Spanish Telegraph Co., Ltd.

THE fifty-eighth general meeting of the shareholders of this company was held on the 16th inst. at Electra House, Finsbury Pavement, E.C., the Marquis of Tweeddale presiding.

The CHAIRMAN, in moving the adoption of the report (see ELECTRICAL REVIEW, page 398), said that the traffic receipts for the year showed an increase of £1,087, which might be considered very satisfactory. The increase was due to the general improvement in the commercial traffic carried by their cables, which dated from the year 1906, and he was glad to say that that improvement was still maintained up to the present time. The working expenses showed an increase of £402 as compared with 1908. That was made up of various items, the principal being an increase of £443 for salaries at their stations, which was accounted for by the normal yearly increases granted to clerks under the salaries scheme, also to the guaranteeing by the company of the employés against fluctuations in the rate of exchange in Spain. Office expenses at stations showed an increase of £51. On the other hand, the repairs and maintenance account showed a decrease of £199, due to the fact that several heavy items of expenditure incurred in 1908 were not necessary in 1909. As stated in the report, the Bilbao cable was interrupted twice during the year, and on both occasions the repairs were carried out promptly. Those repairs cost £3,215, and that amount had been paid out of revenue. The reserve fund now amounted to £54,336. He was glad to say that the value of the company's securities, as compared with this time last year, again showed an improvement. The net result of the operations for the year, was that after placing £5,000 to the reserve fund and the necessary amount to provide for the redemption of the first mortgage debentures, they were able to recommend a dividend of 4 per cent. on the ordinary shares, and to pay the usual 10 per cent. on the preference shares. That left a balance of £57, which had been transferred to the contingency account, which now amounted to £2,559.

SIR J. DENISON PENDER seconded the motion, and the report was adopted.

Calcutta Electric Supply Corporation, Ltd.—The number of units delivered to consumers during the four weeks ended January 28th, 1910, were 482,672 compared with 400,279 units in the corresponding four weeks of 1909.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight.		No. of wks.	Total to date.		Route miles open.	
		£	£*		£	£*		Inc.
Aberdeen	Mar. 16	2,425	+ 193	41	56,193	— 633	..	..
Ayr	,, 12	187	+ 20	48	14,309	+ 107	8	..
Bath	,, 19	1,409	+ 310	11	7,270	+ 915	..	..
Belfast	,, 18	7,567	+ 702	49	191,998	+ 7,844	37	..
†Birkenhead	,, 18	995	+ 56	49	52,890	+ 286	13·63	..
Birmingham Corp.	,, 12	13,681	+1,455	50	331,398	+14,233	56·46	..
Blackburn	,, 16	1,933	+ 212	50½	54,116	— 1,200	14·12	..
Blackpool Corp.	,, 17	879	+ 169	..	54,744	+ 4,658	..	..
Blackpool-Fleetw'd	,, 12	250	+ 31	10	2,275	— 91	..	..
Bolton	,, 18	4,512	+ 583	50	115,010	+ 1,559	26	..
Bournemouth	,, 16	2,946	+ 514	50	81,564	+ 2,253	21·95	..
Bradford	,, 12	9,360	+1,809	49	239,041	+11,185	54·81	..
†Brighton	,, 18	787	+ 155	49½	46,785	+ 2,644	9·5	..
Bristol	,, 18	10,493	+1,836	..	..	..	..	..
Brit. Elec. Trac. Co.								
Airdrie	,, 11	427	+ 32	10	2,155	+ 61	3·65	..
Barnsley	,, 11	358	+ 70	,,	1,675	+ 106	..	..
Barrow	,, 11	454	+ 101	,,	2,190	+ 249	5·37	..
Cavehill	,, 11	114	+ 38	,,	529	+ 10	..	..
Devonport	,, 11	772	+ 158	,,	3,970	+ 325	8·85	..
Gateshead	,, 11	1,931	+ 65	,,	9,422	— 73	11·25	..
Gravesend	,, 11	382	+ 61	,,	1,823	+ 130	6·5	..
Greenock	,, 11	1,050	+ 223	,,	4,892	+ 652	7·25	..
Hartlepool	,, 11	409	+ 47	,,	1,989	+ 104	6·72	..
Kidderminster	,, 11	164	+ 23	,,	805	+ 52	..	..
Leamington	,, 11	313	+ 78	,,	1,397	+ 86	..	..
Merthyr	,, 11	372	— 15	,,	1,830	— 71	2·9	..
Metropolitan	,, 11	13,993	+4,817	,,	64,224	+13,347	22	..
Middleton	,, 11	555	+ 47	,,	2,549	— 201	8·5	..
Mid. Joint Com'tee	,, 11	11,180	+1,466	,,	53,340	+ 2,651	..	..
Oldham—Ashton	,, 11	1,058	— 105	,,	4,982	— 40	9·13	..
Peterborough	,, 11	189	+ 21	,,	937	+ 46	5·31	..
Potteries	,, 11	3,468	+ 223	,,	16,853	+ 32	29	..
Rothesay	,, 11	86	+ 3	,,	420	+ 5	2·75	..
Southport	,, 11	481	+ 110	,,	2,165	+ 67	8·17	..
S. Metropolitan	,, 11	1,513	+ 454	,,	6,986	+ 704	..	..
Swansea	,, 11	1,137	+ 277	,,	9,476	+ 1,188	12·5	..
Tynemouth	,, 11	272	+ 41	,,	1,354	+ 125	3·75	..
Weston-s Mare	,, 11	38	+ 1	,,	2 9	— 2	3	..
‡Worcester	,, 11	470	+ 54	,,	2,303	+ 116	5·75	..
Wrexham	,, 11	176	+ 16	,,	846	— 10	..	..
Yorks. Wool. Dist.	,, 11	1,855	+ 445	,,	9,056	+ 1,039	17	..
Miscellaneous	,, 11	370	+ 50	,,	1,839	+ 117	..	..
†Burnley	,, 12	1,179	+ 110	..	..	..	..	..
†Burton-on-Trent	,, 12	246	+ 16	50	13,102	— 22	6·62	..
†Bury	,, 18	1,058	+ 16	49½	56,472	+ 42	22·5	..
†Cardiff	,, 18	2,015	+ 157	50	108,546	+ 2,928	..	..
†Carlisle	,, 12	155	+ 15	10	1,491	+ 45	..	..
†Chatham and Dist.	,, 10	784	+ 239	10	7,396	+ 771	14·98	..
Cork	,, 17	913	+ 140	..	4,669	+ 240	9·89	..
Croydon	,, 4	3,056	+ 848	..	76,381	+ 9,099	..	..
Darlington	,, 12	357	— 6	50	9,161	— 509	..	..
†Darwen	,, 11	229	+ 27	49	12,049	— 87	4·36	..
Dover	,, 12	341	+ 63	50	10,026	— 132	4·75	..
†Dublin	,, 11	4,983	+ 533	..	49,805	+ 1,976	54·25	..
Dundee	,, 16	2,240	+ 96	43½	51,251	— 648	15·5	..
†East Ham	,, 12	974	+ 108	49½	49,371	+ 5,783	8·52	·77
Exeter	,, 18	589	+ 67	51	15,296	+ 845	5·5	..
†Glasgow	,, 12	17.633	+1,903	..	688,221	— 1,966	47·62	5
†Hastings	,, 17	1,559	+ 226	..	..	..	..	..
†Huddersfield	,, 12	1,674	+ 223	49	82,378	+ 4,918	28·5	·5
†Hull	,, 12	2,743	+ 339	49	130,054	+ 7,354	14·5	1·5
Ilkeston	,, 17	217	+ 2	50	6,601	— 237	..	..
†Ipswich	,, 12	326	+ 41	50	19,278	+ 518	10·5	..
†Kilmarnock	,, 12	134	+ 4	43	6,243	— 207	4·25	..
Lancashire United	,, 16	2,488	+ 218	..	12,736	+ 295	39	..
Leeds	,, 12	13,391	+2,043	49	335,090	+13,229	..	..
Leicester	.. ..	..	..	..	..	..	..	..
†Leith	,, 12	563	+ 107	43½	25,481	+ 8,018	9	3
Liverpool	Feb. 26	20,747	+ 660	8½	85,341	+ 1,513	109·5	2
‡L.C.C.	Mar. 5	78,324	+18,523	..	1,819,333	+128,416	131·5	9·12
London United	,, 19	11,074	+1,460	..	59,235	+ 5,857	..	..
†Lowestoft	,, 6	102	+ 26	23	3,278	+ 920	3·5	..
†Manchester	,, 12	14,682	+1,234	50	737,433	— 777	183	1
†Newcastle	,, 12	3,758	+ 109	..	192,384	— 1,212	14·5	..
Newport	,, 15	627	+ 75	50	32,423	+ 463	14·5	..
†Oldham	,, 13	1,635	— 150	50	89,303	— 7,188	23·75	..
†Pontypridd	Feb. 26	358	+ 17	47½	19,314	+ 1,223	5·5	..
Portsmouth	Mar. 12	3,422	+ 573	50	99,893	+ 4,321	14·5	·75
†Preston	,, 9	669	+ 89	..	..	..	..	..
Rotherham	,, 8	1,060	— 25	44	26,087	— 992	12	2
Salford	,, 11	8,967	+1,076	49½	225,176	— 1,554	..	..
†Sheffield	,, 13	5,786	+ 794	50½	286,427	+ 8,888	39·62	2·62
†Southampton	,, 9	967	+ 101	44	51,966	+ 622	..	..
Southend-on-Sea	,, 16	805	+ 281	50	25,120	+ 3,796	..	..
†South Shields	,, 12	603	+ 22	49½	27,512	+ 148	..	..
Swindon	.. ..	..	..	..	..	..	..	..
Tyneside	,, 16	753	+ 46	11	3,785	— 233	..	..
Wallasey	,, 5	1,571	+ 62	48½	43 814	+ 903	..	..
†Walthamstow	,, 12	611	+ 142	50	32,074	+ 1,738	9	..
West Ham	,, 10	4,729	+1,058	49½	115,464	+ 8,553	15·25	..
Wolverhampton	,, 16	1,702	+ 869	50	42,731	+ 2,417	12·5	1·75
†Baker St.-Waterloo	,, 12	3,460	+ 100	10	34 885	+ 515	4·25	..
†Cen. London Rly.	,, 12	5,694	+ 152	10	55,860	— 407	6·32	·55
Char. +, Hus. Hamp.	,, 12	3,750	+ 80	10	33,295	+ 80	7·75	..
City & S. Lon. Rly.	,, 20	6,636	— 116	11	56,833	— 751	7·26	..
Dublin-Lucan Rly.	,, 18	241	+ 39	11	1,143	— 26	7	..
†G.N. and City Rly.	,, 12	1 475	— 82	10	15,568	— 416	3.5	..
†G.N., P'ty. & Brmin.	,, 12	6,165	+ 355	10	61,790	+ 2,890	9·25	..
†L'pool Overh'd Rly	,, 13	1,804	+ 74	..	14,103	— 115	6·8	4·8
†Llandudno-Col. Bay	,, 11	188	+ 44	14½	1,694	+ 164	..	..
†Mersey Railway	,, 12	1,948	+ 31	10	19,772	+ 285	4·5	..
†Metropolitan Rly.	,, 13	16,213	+ 818	..	164,241	+ 5,874	34·5	..
†Met. District Rly.	,, 12	11.003	+1,491	10	108,471	+10,564	24	..
Anglo-Argentine	,, 18	89 481	+6,891	..	472,191	+38,718	..	..
§Auckland	Feb.	14,577	+ 790	..	..	..	22·3	1·88
Bombay (B.E.T.)	,, 4	5,285	+ 377	5	18,023	+ 944	..	..
§Brisbane	,,	15,750	+1,984	8	33,840	+ 3,714	..	..
§Brit. Columbia Rly.	..	..	..	..	..	..	..	..
†Calcutta	Mar. 19	7,340	+ 570	..	..	..	..	..
§Cape Electric T. Ltd.	..	..	..	..	..	..	..	..
§Kalgoorlie, W.A.	Feb	3,185	..	..	6,357	..	20·5	..
Madras	Mar. 15	1,319	+ 74	..	6,673	+ 280	..	..
§Lisbon	..	..	..	..	..	..	..	..
†Perth (W.A.)	,, 11	1,517	+ 105	..	15,940	+ 925	28	

* Compared with the corresponding period of 1909. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Saturday Morning.

The rise in the Bank Rate to 4 per cent. and the near approach of the Easter holidays have had some effect in laying a check upon Stock Exchange business. Investment stocks were the more particularly affected. Rubber shares rise with the perseverance of Tennyson's Brook, and an outstanding feature is a sharp advance in the price of Metropolitan District Ordinary.

Allotments of the new issue of New York Telephone 4½ per cent. scrip appeared very promptly, and a number of applicants received no more than 10 per cent. of what they wrote for. The cash price fell to ¼ premium, and bargains were done at par, *i.e.*, the price of issue, but as soon as the first batch of stags had been disposed of the quotation rallied to ⅜ premium.

While the Home Railway market, as a whole, has tended to slightly lower values, on the rise in the Bank Rate and the prospect of wintry weather at Easter, the buying of Districts was resumed with vigour, and again the stock shows a substantial improvement. Metropolitans, too, were further advanced, but in their case the full rise was not held, it being contended that the appreciation in "Mets." had been more than sufficient to discount Exhibition prospects. On the other hand, the District rise is backed by the satisfactory figures of the Underground Electric Railways Company. The latter announced on Friday that nothing could be paid, by way of interest, on the Income bonds at present, but this did not prevent the price hardening to a small extent.

Central Londons are quiet, though steady. City and South London were put up about ½, but lost the fraction afterwards. The continued good traffics of the Brighton Railway are declared by some to be due, for the greater part, to the newly electrified section.

Interest in the Rubber market has waned hardly at all, notwithstanding the Bank Rate and the holidays. The price of the product itself is so high—malice says it is rigged—that the tone of the share market cannot help sympathising, and almost every day sees a fresh series of gains. New companies meet with a fair measure of support, and the cry is "Still they come."

Mention of new issues is a reminder that the appeal of the Lacroze Tramways, of Buenos Ayres, is said to have met with a cold response from the public. The price has fallen to 3 discount. An interesting prospectus, out a day or two ago, was that of the North Metropolitan Tramways Debenture issue. There would seem to be better investments. The shares of the North Metropolitan Tramways Company, which are of the nominal value of £4 8s., and are fully paid, stand about 4s. They received a dividend of sixpence a share last month.

London United Tramways Preference shares are 5s. higher, securing their usual gain on the eve of the Easter holiday; the Debenture stock stays at 71½. British Columbia Electric Railway Deferred is a strong feature, and Anglo-Argentine Tramways shares of both classes are better.

Telegraph and telephone issues are very unexciting. American Telephone and Telegraph capital stock has lost a point, dropping to 144. Business is moderately active in the National Telephone descriptions. Marconi's have slipped back to 12s. 6d.

In the electricity supply market a good many of the leading shares were marked *ex* dividend last Wednesday, and prices look cheap in several cases. From Charing Cross Ordinary 2s. 6d. was deducted, and this has been recovered, the price consequently being unaltered. South Londons, *ex* 4s., were marked down 10s., Chelseas and Metropolitans are *ex* 2s. 6d., County of London Ordinary and Preference, 6s., Kensingtons 4s., and Notting Hills 9s., London Electric Ordinary are *ex* 1s. 2½d., the Preference 3s., and Oxfords 4s. 6d. Up to the present it must be admitted that the deductions have had little effect in stimulating business, and the electric lighting department is one of the investment markets where a rise in the Bank Rate has always a restraining influence over orders.

Winchester Electric Light Co., Ltd.—Mr. T. F. Kirby presided at the annual meeting held on March 15th. Some reference was made to the decision of the Town Council to purchase the undertaking, their notice to do which expires on January 20th, 1911, but the chairman stated that the directors were not in a position to give any information to the shareholders beyond what was already known. The Town Council were acting within their powers, and the purchase-money would be equal to the amount of capital which had been raised by the company, plus 10 per cent.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1906.	1907.	1908.	1909.	Closing Quotations March 15th.	Closing Quotations March 19th.	Business done week ended March 19th, 1910. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	8⅜ — 8⅞	8⅜ — 8⅞	..	..	..	Nil.
116,200	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	5 %	5 %	5 %	5 %	100 —102	100 —102	..	..	..	4 18 0
$235,196,600	American Telephone & Telegraph, Cap. Stock ..	$100	8 %	8 %	8 %	8 %	144 —146	143 —145	..	..	—1	5 10 4
$58,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 58,001 to 73,000	$1000	4 %	4 %	4 %	4 %	94 — 96	94 — 96	..	..	..	4 3 4
558,460	Anglo-American Telegraph	Stock	3⅞%	3¼%	£3 4s.	3⅜%	59½ — 61½	59½ — 61½	..	..	..	6 1 0
3,220,770	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	6 %	102½ —103½	102½ —103½	102½	..	..	ɒ 16 3
3,220,770	Do. do. do. Deferred	Stock	1⅝%	1 %	8/-	25/-	19½ — 19⅞	19⅝ — 19⅞	..	..	..	6 7 0
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	99½ —101½	99½ —101½	..	..	..	4 18 6
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	..	8 — 8¼	8 — 8¼	..	..	..	4 17 0
2,449,116	Commercial Cable, Sling. 600 year 4% Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	87½ — 89½	87½ — 89½	88¼	..	..	4 9 5
16,000	Cuba Telegraph	10	5 %	6 %	6 %	..	8¼ — 9¼	8¼ — 9¼	..	..	..	6 9 9
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	16⅝ — 17⅝	17 — 18	17⅝	..	+ ⅛	5 11 1
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	..	3⅛ — 3⅜	3⅛ — 3⅜	..	..	..	6 5 0
6,000	Do. do. 10 % Cum. Pref. ..	10	10 %	10 %	10 %	10 %	8 — 8½	8 — 8½	..	..	..	4 8 8
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 8
60,7101	Direct United States Cable	20	4⅝%	4½%	4½%	..	13⅜ — 14⅛	13⅞ — 14⅛	14	13⅞	+⅛	5 16 3
48,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 8
4,000,000	Eastern Telegraph, Ord. Stock..	Stock	7 %	7 %	7 %	..	136 —139	136 —139	138	137½	..	5 0 9
2,000,000	Do. 8½ % Pref. Stock..	100	8½%	8½%	8½%	8½%	86 — 88	86 — 88	86	..	..	4 1 5
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	102½ —104½	102½ —104½	102½	..	..	5 4 8
800,000	Eastern Extension, Australasia, and China Tele	10	7 %	7 %	7 %	..	12⅜ — 13⅛	12⅜ — 13⅛	18½	13⅛	+ ⅛	5 4 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..	3 17 8
2 10,000‡	East. & S. Afric. Tel., 4 % Mt Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100½—102½	..	..	+ ½	3 18 1
181,127	Globe Telegraph and Trust	10	5½%	5½%	5½%	..	10½ — 11	10½ — 11	10⅞	..	..	5 4 7
181,127	Do. do. 6 % Pref...	10	6 %	6 %	6 %	6 %	13⅜ — 13⅝	13⅜ — 13⅝	13 7/16	13 7/16	..	4 7 8
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	20 %	20 %	18 %	..	30½ — 31½	30½ — 31½	..	..	..	5 9 1
14,800	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 8
17,000	Indo-European Telegraph	25	18 %	18 %	18 %	..	53½ — 55½	53½ — 55½	..	..	..	6 14 6
$41,880,400	Mackay Companies Common	$100	8½%	4 %	4 %	4½%	93 — 95	91 — 93 xd	..	..	..	4 11 5
$60,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	79 — 83	78 — 80 xd	..	..	..	5 0 0
894,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	2⅛ — 2⅜	2⅛ — 2⅜	13/6	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	6 %	6 %	6 %	..	⅞ — 1	⅞ — 1	..	..	..	6 0 0
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	⅝ — ¾	⅝ — ¾	..	..	..	5 6 8
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	104½ —106	104½ —106	104⅛	104⅛	..	5 13 2
3,725,000	Do. do. Def. Stock	100	5 %	6 %	6 %	6 %	123½ —125½	123½ —125½	124⅛	124⅛	..	4 15 7
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10½ — 10¾	10½ — 10¾	..	..	..	5 10 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10 — 10¼	10 — 10¼	..	..	..	5 11 8
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅝ — 5⅞	5⅝ — 5⅞	5 7/8	..	..	4 8 11
2,000,000	Do. do. 8½ % Deb. Stock Red. ..	Stock	8½%	8½%	8½%	8½%	98 —100	98 —100	89⅛	..	..	3 10 0
1,983,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100 —102	100 —102	101½	..	..	3 18 5
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	7 %	8 %	8 %	..	1 3/16 — 1 5/16	1 3/16 — 1 5/16	..	..	..	5 6 1
50,000	Do. do. do. 6 % Cum. Pref... ..	1	6 %	6 %	6 %	6 %	1 3/16 — 1 5/16	1 3/16 — 1 5/16	..	..	..	4 14 9
196,955	Do. do. do. 4 % Red. Deb. Stock ..	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..	4 10 11
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..	4 0 0
11,889	Reuter's	8	5 %	5 %	5 %	..	7⅞ — 8¼	7⅞ — 8¼	..	..	..	4 18 9
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 8
3,042	Submarine Cables Trust	Cert.	6 %	6 %	6 %	..	130 —133	131 —134	..	..	+1	4 9 7
120,000	United River Plate Telephone	5	8 %	8 %	8 %	..	7 7/16 — 7 7/8	7 7/16 — 7 7/8	..	..	..	5 7 9
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	..	..	..	4 8 11
30,008	W. Coast of America, 1 to 30,000 & 58,001 to 58,008	2½	2½%	2½%	2½%	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	3 16 4
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..	4 0 0
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980.. ..	10	7 %	7 %	7 %	..	13⅜ — 14⅛	13⅜ — 14⅛	13⅞	13⅜	..	4 18 8
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	101 —103	101 —103	101	..	..	3 17 8
88,821	West India and Panama Telegraph	10	Nil	Nil	Nil	..	1⅛ — 1 5/16	1⅛ — 1 5/16	..	..	..	Nil
34,568	Do. do. 6 % Cum. 1st Pref. ..	10	8 %	6 %	6 %	..	8⅞ — 9¼	8⅞ — 9¼	..	..	..	6 9 9
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	£2 6	15 %	..	8¾ — 9⅛	8¼ — 1¼	..	..	— ¼	6 9 9
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	100½—102½	101 —103	..	..	+ ½	4 17 1

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5 % Cum. 1st Pref., 1 to 640,000	5	..	..	..	5 %	4⅛ — 4⅜	4 5/16 — 4 13/16	93/9	90/-	+ 1/16	5 6 1
500,000	Do. 5 % 2nd Pref., 800,001 to 1,300,000	5	..	..	..	5 %	4⅛ — 4⅜	4⅛ — 4½	88/9	88/1½	+ ⅛	5 11 1
4,465,674	Do. 4 % Deb. Stock	Stock	..	..	4 %	4 %	90 — 91⅛	90 — 91½	91⅛	90⅛	..	4 7 5
692,387	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	104 —106	104 —106	..	..	..	4 14 4
680,000	Babcock & Wilcox, 1 to 680,000	1	20 %	20 %	20 %	..	5 5/16 — 5 7/16	5 5/16 — 5 7/16	5⅛	..	..	3 16 2
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1 3/16 — 1 5/16	1 3/16 — 1 5/16	..	..	..	3 19 2
60,000	British Aluminium, Ord., 1 to 40,000	5	7 %	7 %	Nil	..	½ — ⅝	½ — ⅝	..	..	..	Nil
60,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	3½%	..	1 — 1⅛	1 — 1⅛	..	..	..	..
40,100	Do. do. "A" 6 % Cum. Pref.	5	6 %	6 %	6 %	..	2⅛ — 2⅜	2⅛ — 2⅜	..	..	..	..
12,897	Do. do. 4 % Funding Certs.	5	4 %	4 %	2 %	..	⅝ — ¾	⅝ — ¾	..	..	..	..
124,400	Do. do. 5½ % Loch Leven Debs.	100	5½%	5½%	5½%	5½%	95 — 98	95 — 98	..	..	..	..
500,000	British Columbia E. Rail Def. Ord. Stock ..	100	6 %	8 %	8 %	8 %	143 —147	145 —149	..	..	+2	5 7 5
400,000	Do. Pref. Ord. Stock	100	5 %	5 %	6 %	6 %	119 —123	122 —126	122	..	+3	4 15 3
400,000	Do. 5 % Cum. Perp. Pref. Stock ..	100	5 %	5 %	5 %	5 %	110½—112½	110½ —112½	112	..	..	4 8 11
288,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250 ..	40	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
312,600	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	101 —104	101 —104	108⅜	..	..	4 6 7
188,301	British Electric Traction	10	Nil	Nil	Nil	..	1 — 1½	1 — 1½	23/9	..	..	Nil
161,487	Do. do. 6 % Cum. Pref.	10	6 %	3 %	1½%	..	2⅞ — 3⅛	2⅞ — 3⅛	65/-	62/6	..	4 8 11
1,478,658	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	90 — 93	90 — 93	91½	91	..	5 7 6
698,986	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	..	68 — 73	68 — 73	70	..	..	6 6 8
100,000	British Insulated and Helsby Cables	5	10 %	10 %	10 %	10 %	7⅞ — 7⅞	7⅞ — 7⅞	..	..	..	6 7 0
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	6⅞ — 6⅞	6⅞ — 6⅞	..	..	..	4 10 7
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
304,940‡	British Thomson-Houston 4½ % 1st Mort. Debs.	100	4½%	4½%	4½%	4½%	87 — 92	87 — 92	..	..	..	4 17 10
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 75,000	5	Nil	Nil	Nil	..	3/16 — 5/16	3/16 — 5/16	..	..	..	Nil
1,816,858	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	..	47 — 51	47 — 51	..	..	..	7 16 10
50,000	Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	..	3/16 — ¼	3/16 — ¼	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,976	Brush Electrical Engineering, Ord., 1 to 105,781 ..	1	Nil	Nil	Nil	..	0 — ¼	0 — ¼	..	..	..	Nil
200,000	Do. do. Non-cum. 6 % Pref.	1	Nil	Nil	Nil	..	0 — ¼	0 — ¼	..	..	..	Nil
195,000‡	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	39 — 44	39 — 44	..	..	..	10 4 6
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	25 — 29	25 — 29	..	..	..	15 3 0
127,610	Calcutta Trams, 1 to 127,610	5	8 %	6 %	4½%	..	4 — 4½	4 — 4½	87/6	..	..	5 0 0
45,804	Do. 5 % Cum. Pref., Nos. 1 to 29,880..	5	5 %	5 %	5 %	5 %	4⅜ — 5	4⅜ — 5	..	..	..	5 0 0
350,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
85,000	Callender's Cable Construction shares	5	15 %	15 %	15 %	..	10½ — 11	10½ — 11	..	..	..	6 0 0
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜ — 5½	5⅜ — 5½	..	..	..	4 10 11
200,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102½—104½	102½—104½	..	..	..	4 6 2
491,222	Cape E. Trams., 1 to 491,222	1	Nil	Nil	Nil	..	½ — ⅝	½ — ⅝	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	8 %	13 %	12½%	..	2⅜ — 2¾	2⅜ — 2¾	50/-	48/9	..	5 0 0
210,158	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4 %	4½%	104 —107	104 —107	..	..	..	4 4 1
1,690,690	Central London Railway, Ord. Stock	Stock	4 %	3 %	3½%	3 %	70 — 72	70 — 72	70⅛	..	..	4 3 4
554,555	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..	4 13 0
554,555	Do. do. Def. do.	Stock	4 %	2 %	2½%	2 %	52 — 54	52 — 54	53¼	..	..	3 14 1
1,490,000	City and South London Railway	Stock	2½%	2½%	1½%	1½%	30½ — 31⅛	31 — 32	31⅛	30½	+ ⅛	5 9 5
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	5 %	Nil	..	3/16 — ¼	3/16 — ¼	..	..	..	Nil
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 900 of £100, and 901 11,000 of £50 Red	..	5 %	5 %	5 %	5 %	88 — 91	88 — 91	..	..	..	5 9 11

* Unless otherwise stated, all shares are fully paid. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued.*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1906.	1907.	1908.	1909	Closing Quotations March 15th,	Closing Quotations March 19th.	Business done week ended Mar. 19th, 1910. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	6 %		7/8 — 1	7/8 — 1	..	..	..	6 0 0
805,000	Do. do. 6 % Cum. Pref., 1 to 805,000	1	6 %	6 %	6 %	6 %	1 1/16 — 1 3/16	1 1/8 — 1 3/16	..	..	..	5 9 1
271,080	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	13 — 14	13 — 14	..	..	..	4 7 8
99,261	Edison & Swan Utd., "A" shs., £8 pd., 1 to 99,261	5	4½%	2½%	Nil	..	3/16 — 5/32	3/16 — 5/32	..	..	+ 1/32	Nil
17,189	Do. "A" shares, 01—017,189	5	4½%	2½%	Nil	..	1 — 1⅛	1 — 1⅛	..	..	..	Nil
307,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	65 — 70	65 — 70	..	..	..	5 14 4
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	81 — 84	81 — 84	..	..	..	5 19 1
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	7 %	7 %	7 %	7 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	10 4 0
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	7 3/16 — 7 5/16	7 3/16 — 7 5/16	..	..	..	6 1 3
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	83 — 87	83 — 87	..	..	..	4 12 0
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	4 %	Nil	..	3/8 — 7/16	3/8 — 7/16	..	..	..	Nil
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	..	..	10½ — 10¾	10½ — 10¾	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	..	102 —103½	102 —103½	..	..	+ ½	4 16 10
40,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15%	15 %	15 %	13¼ — 13⅝	12⅝ — 13⅜ xd	..	..	..	5 18 6
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5⅛ xd	5 — 5⅛	..	..	..	4 3 9
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	105¾—107⅛	105¾—107⅛	..	..	..	4 3 9
50,000	India-Rubber, Gutta-percha & Telegraph Works.	10	10 %	10 %	10 %	10 %	15¾ — 16	15¾ — 16	15⅝	..	..	6 5 0
37,500	†Liverpool Overhead Railway, Ord.	10	Nil	½%	Nil	Nil	1 3/16 — 1 1/8	1 3/16 — 1 1/8	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	4⅞ — 5¼	4⅞ — 5¼	..	..	..	9 10 6
600,070	London United Trams. (1901), 1 to 50,007	10	3 %	3 %	Nil	..	1½ — 2⅛	1½ — 2⅛	..	..	..	Nil
899,980	Do. do. 50,008 to 100,000	10	3 %	3 %	Nil	..	1¼ — 2⅛	1¼ — 2⅛	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	3⅜%	..	2⅜ — 2⅝	2⅜ — 3⅛	52/6	..	— ⅜	11 10 10
1,649,980	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	..	4 %	4 %	70 — 73	70 — 73	..	..	..	5 9 7
5,782,062	Metropolitan Consolidated	100	1 %	½%	1 %	..	43⅛ — 44⅛	43⅛ — 44⅛	44⅜	44	..	2 5 2
2,640,914	Do. Surplus Lands	100	2¾%	2¾%	2¾%	2¾%	68 — 70	68 — 70	69⅜	69⅛	..	3 18 7
3,285,000	Do. District	100	Nil	Nil	Nil	Nil	19 — 19⅛	20⅛ — 21	20 1/16	19⅜	+ 1⅛	Nil
891,337	Metropolitan Electric Trams., Ord.	1	..	..	4½%	..	⅛ — ¼	⅛ — ¼	..	..	..	6 10 11
814,016	Do. do. Defd.	1	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
600,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/16 — 1/8	1/16 — 1/8	..	..	..	6 3 1
595,600	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 1
$10,823,200	Mexico Trams Co., Common Stock	..	..	..	..	..	133 —135	133 —135	133⅛	..	..	..
$9,000,000	Do. 1st Mort. 50-year 5% Gld. Bds.	..	..	..	5 %	..	94⅜ — 95⅜	94⅜ — 95⅜	95⅜	95⅛	..	5 0 8
245,500	Potteries Electric Traction	1	4 %	4 %	Nil	..	3/16 — 5/16	3/16 — 5/16	..	..	..	..
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	3/16 — 5/16	3/16 — 5/16	..	..	..	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	84 — 87	84 — 87	..	..	..	5 3 6
87,350	Telegraph Construction and Maintenance	12	15 %	17½%	15 %	17½%	35½ — 37	34 — 35½ xd	34⅜	..	..	5 16 0
140,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
1,000,000	Underground Electric Railway, 5% Prior Lien	..	..	..	5 %	..	102 —103	102 —103	..	..	..	4 17 1
2,800,000	Do. do. 4½% Bonds	..	..	..	4½%	4½%	89 — 91	89 — 91	89⅝	..	..	4 18 4
4,900,000	Do. do. 6% Income Bonds	..	..	..	..	..	34 — 36	35 — 37	36	35⅜	+1	..
66,666	Willans & Robinson, 1 to 80,000 & 80,001 to 116,666	1	Nil	10 %	5 %	..	1/16 — 1/8	1/16 — 1/8	..	..	..	..
66,666	Do. 6 % C.P., 80,001 to 80,000 & 126,001 to 141,666	5	..	6 %	6 %	6 %	1½ — 2⅛	1½ — 2⅛	..	..	..	2 8 4
245,495	Do. % 1st Mort. Deb. Stock		4 %	4 %	4 %	4 %	68 — 73	68 — 73	..	..	..	5 9 7

ELECTRICITY SUPPLY COMPANIES.

15,000	Bromley (Kent) E.L. & P., 1 to 15,000	5	5½%	5½%	5½%	..	4½ — 4⅝	4½ — 4⅝	..	..	..	5 15 9
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	91 — 94	91 — 94	..	..	..	4 18 9
80,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 80,000	5	10%	10 %	10 %	10 %	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..	6 1 8
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅛ — 7⅜	7⅛ — 7⅜	..	..	..	4 4 10
400,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	5 %	4 — 4⅛	4 — 4⅛ xd	..	..	..	5 11 1
80,000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4 — 4⅛	4 — 4⅛	81/3	..	..	5 0 0
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅞ — 4⅛	3⅞ — 4⅛	..	..	..	5 2 10
446,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96⅜ — 98½	96⅛ — 98½	..	..	..	4 1 3
49,486	Chelsea Electricity Supply, Ord.	5	4½%	4½%	4½%	4½%	8⅜ — 4½	3½ — 4 xd	..	..	..	5 12 6
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	7 %	12 — 12⅛	11⅞ — 12⅜	12⅛	..	— ⅛	5 13 2
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	12¼ — 13⅛	12⅛ — 13⅛	..	..	..	4 10 7
400,000	Do. 5 % Db. Stk.	Stock	5 %	5 %	5 %	5 %	121 —125	121 —125	..	..	..	4 0 0
800,000	Do. 4½ % 2nd. Db. Stk.	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
50,000	County of Durham Electrical Power, Ord.	5	4 %	2 %	Nil	Nil	⅛ — 2	1½ — 2	..	..	..	5 0 0
50,000	Do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	2⅜ — 3⅜	2⅜ — 3⅜	..	..	..	7 8 2
250,000	Do. do. 5 % 1st Mtg. Deb.	Stock	..	..	5 %	5 %	94 — 96	94 — 96	..	..	..	5 4 2
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	5 %	7⅝ — 8⅜	7⅜ — 8⅛ xd	..	8	..	6 3 1
55,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10⅜ — 11⅛	10⅛ — 11 xd	10⅛	..	..	5 9 1
400,000‡	Do. do. 4½ % Deb. Stock	Stock	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	100 —103	99 —102	..	..	..	4 7 5
80,000	Edmundson's Electric Corporation, Ord. Shares	5	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	8 %	Nil	Nil	..	1⅛ — 1¼	1 — 1⅛	..	..	— ¼	Nil
480,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	..	71 — 74	71 — 74	..	..	..	6 1 7
$8,150,000	Electrical Dev.Co.of Ontario, 6% 1stMtg.Gold Bnds.	$500	..	..	5 %	5 %	80 — 83	80 — 83	82½	81¼	..	6 0 6
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅜ — 4⅞	4⅜ — 4⅞	..	..	..	5 12 10
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	5 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	4 13 9
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
15,000	Hove, 1 to 15,000	5	9 %	8½%	8½%	8½%	7 — 7½	7 — 7½	..	..	..	5 13 4
$1,376,000	Kaministiquia Power Co., 5 % Gold Bnds.	100	..	..	5 %	5 %	102½—104½	102½—104½	..	..	..	4 15 8
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	8 %	8 %	7⅛ — 7⅜	7 — 7⅜ xd	..	..	..	5 6 8
90,000	Do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	94⅜ — 96½	94½ — 96⅜	..	..	..	4 2 11
111,000	London Electric Supply Corporation, Limited, Ord.	3	4 %	2½%	3 %	..	1⅜ — 2⅛	1⅜ — 2 xd	..	..	..	4 8 11
70,000	Do. do. 6 % Pref.	5	6 %	6 %	6 %	..	5 — 5⅜	4⅝ — 5⅜ xd	..	..	..	5 11 8
882,355	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4½%	4½%	4 %	4 %	92 — 94	92 — 94	92½	..	..	4 5 1
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8 %	6¾%	5 %	5 %	4⅛ — 4⅜	4 — 4⅛ xd	..	..	..	5 11 1
75,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜ — 5	4⅜ — 5	..	..	..	4 10 0
235,000	Do. 4½ % 1st Mort. Deben. Stock	Stock	4½%	4½%	4½%	4½%	104 —107	104 —107	..	..	..	4 4 1
248,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	83 — 86	83 — 86	85½	..	..	4 1 5
$6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	100	5 %	5 %	5 %	..	84⅜ — 85⅛	85 — 86	85¼	85⅛	+ ⅛	5 16 3
18,585,000	Do. Light and Power Co., Ltd., Common	$100	..	..	3½%	..	82⅜ — 84⅜	81 — 83	83	82	—1½	4 4 4
$2,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	7 %	7 %	104 —106	104 —106	105	104⅜	..	6 12 1
12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	100	..	..	5 %	5 %	90⅜ — 91⅜	90⅜ — 91⅜	91½	90½	..	5 9 0
950,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	96⅜ — 98½	96⅜ — 98⅜	..	..	..	4 11 5
180,491	Newcastle-on-Tyne, 1 to 187,500	5	8 %	8 %	2½%	..	4½ — 4⅝	4½ — 5	..	..	+ ⅛	2 10 0
187,500	Do. 5 % Pref., 1 to 187,500	5	5 %	5 %	5 %	5 %	4⅜ — 5	4½ — 5	..	..	..	5 0 0
126,500	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,265	100	..	..	..	5 %	99 —101	99 — 101	..	..	..	4 19 0
10,852	Notting Hill Electric Lighting	10	7½%	7½%	7 %	..	12⅛ — 13⅛	11⅞ — 12⅜ xd	..	..	..	5 9 10
20,000	Oxford, 1 to 96 and 407 to 20,810	5	7 %	7 %	7 %	7 %	6⅜ — 6⅝	6¼ — 6½ xd	..	..	..	5 3 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..	4 2 6
119,694	River Plate Elcty. Co. Ord. Nos. 1 to 120,807	1	2½%	6 %	3 %	..	1⅜ — 2	1 15/16 — 2 1/16	38/6	..	+ 1/16	3 17 7
100,000	Do. do. 6% Non Cum. Pref. Nos. 1 to 100,000	1	6 %	6 %	6 %	6 %	1 3/32 — 1 5/32	1 3/32 — 1 5/32	..	..	..	4 16 0
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	102⅛—104½	102⅛—104½	105	103	..	4 15 8
40,000	St. James' and Pall Mall Electric Light, Ord.	5	10 %	10 %	10 %	10 %	8⅝ — 9	8⅝ — 9	..	..	..	5 10 4
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	4 16 7
160,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	83 — 87	83 — 87	..	..	..	4 0 6
12,000	Smithfield Markets Electric Supply, Ord.	5	Nil	Nil	Nil	..	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	Nil
65,000	South London Electric Supply, Ord.	4	8 %	4 %	5 %	5 %	2¼ — 3⅛	2⅛ — 2⅜ xd	..	..	..	7 13 0
180,100	Do. do. 5 % 1st Mort. Deb.	100	..	..	5 %	5 %	100 —103	100 —103	..	..	..	..
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	2½%	..	1/16 — 1/8	1/16 — 1/8	..	..	..	4 8 11
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8 xd	..	..	..	6 17 11
224,520	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	½ — 1	½ — 1	12/6	..	..	25 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	1⅝ — 2⅛	1⅝ — 2⅛	..	..	..	10 10 6
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	78 — 82	78 — 82	..	..	..	5 9 9
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 808,000	1	..	..	5 %	..	33/32 — 35/32	33/32 — 35/32	..	..	..	6 6 8
100,00	Westminster Electric Supply, Ord.	5	12 %	10 %	10 %	10 %	8½ — 9	8½ — 9	5 5/16	..	..	5 11 1
51,279	Do. do. 4½ % Cum. Pref. Reduced from 5% since 31st Dec., 1905)	5	4½%	4½%	4½%	4½%	4⅜ — 5⅛	4⅜ — 5⅛				4 3 9

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 4 per cent., March 17th, 1910.

TRADE STATISTICS OF CAPE COLONY.

The following figures, showing the imports of electrical and similar materials into Cape Colony in 1908, are taken from the recently issued trade statistics; figures for 1907 are added for purposes of comparison, and notes of any increases or decreases are given.

	1907.	1908.	Increase or decrease.
Brass manufactures.—	£	£	£
From Great Britain ...	11,000	6,000	— 5,000
„ Germany	1,000	—	— 1,000
„ United States ...	2,000	1,000	— 1,000
„ Other countries ...	1,000	—	— 1,000
Total ...	15,000	7,000	— 8,000
Coal.—			
From Great Britain ...	75,000	45,000	— 30,000
„ United States ...	156,000	162,000	+ 6,000
„ Other countries ...	2,000	1,000	— 1,000
Total ...	233,000	208,000	— 25,000
Copper manufactures.—			
From Great Britain ...	1,100	1,200	+ 100
„ Other countries ...	100	100	—
Total ...	1,200	1,300	+ 100
Earthenware and chinaware manufactures.—			
From Great Britain ...	44,000	37,000	— 7,000
„ Austria	1,000	1,000	— —
„ Germany	15,000	13,000	— 2,000
„ Other countries ...	3,000	2,000	— 1,000
Total ...	63,000	53,000	— 10,000
Electrical cable and wire.—			
From Great Britain ...	27,000	19,000	— 8,000
„ Germany	—	2,000	+ 2,000
„ United States ...	2,000	1,000	— 1,000
Total ...	29,000	22,000	— 7,000
Electrical fittings, including posts.—			
From Great Britain ...	14,000	12,000	— 2,000
„ Germany	5,000	11,000	+ 6,000
„ United States ...	3,000	4,000	+ 1,000
Total ...	22,000	27,000	+ 5,000
India rubber, manufactured.—			
From Great Britain ...	7,000	9,000	+ 2,000
„ United States ...	1,000	2,000	+ 1,000
„ Other countries ...	1,000	1,000	—
Total ...	9,000	12,000	+ 3,000
Instruments, mathematical and scientific.—			
From Great Britain ...	4,000	3,000	— 1,000
„ Germany	1,000	1,000	—
Total ...	5,000	4,000	— 1,000
Lamps and lampware.—			
From Great Britain ...	9,000	6,000	— 3,000
„ Germany	7,000	6,000	— 1,000
„ United States ...	4,000	3,000	— 1,000
Total ...	20,000	15,000	— 5,000
Cranes, elevators and lifts.—			
From Great Britain ...	17,000	4,000	— 13,000
„ United States ...	1,000	1,000	—
Total ...	18,000	5,000	— 13,000
Electrical machinery.—			
From Great Britain ...	56,000	15,000	— 41,000
„ Germany	6,000	4,000	— 2,000
„ United States ...	31,000	33,000	+ 2,000
„ Other countries ...	1,000	—	— 1,000
Total ...	94,000	52,000	— 42,000
Mining machinery.—			
From Great Britain ...	259,000	111,000	— 148,000
„ Germany	2,000	3,000	+ 1,000
„ United States ...	109,000	64,000	— 45,000
„ Other countries ...	2,000	1,000	— 1,000
Total ...	372,000	179,000	— 193,000
Railway rails.—			
From Great Britain ...	13,000	3,000	— 10,000
„ Germany	2,000	—	— 2,000
Total ...	15,000	3,000	— 12,000
Locomotives.—			
From Great Britain ...	7,000	5,000	— 2,000
„ Germany	1,000	—	— 1,000
Total ...	8,000	5,000	— 3,000
Tar.—			
From Great Britain ...	2,000	3,000	+ 1,000
Telegraph and telephone material.—			
From Great Britain ...	3,000	2,000	— 1,000
„ Germany	1,000	1,000	—
„ Sweden	1,000	1,000	—
Total ...	5,000	4,000	— 1,000
Tramway rails.—			
From Great Britain ...	1,000	—	— 1,000
„ Belgium	1,000	—	— 1,000
„ Germany	2,000	—	— 2,000
„ United States ...	—	1,000	+ 1,000
Total ...	4,000	1,000	— 3,000
Tramway rolling-stock.—			
From Great Britain ...	3,000	2,000	— 1,000
„ Germany	1,000	—	— 1,000
Total ...	4,000	2,000	— 2,000

METER-READING CARDS AND CONSUMERS' LEDGERS.

By H. F. W. Rasmussen.

After the article by Mr. Petersen on "Meter-Reading Books and Consumers' Ledgers,"* and the correspondence on the same, it would, perhaps, be interesting to some readers of the Electrical Review to know the particulars of a card system which is used by a large number of electricity supply companies, both large and small, and in which the consumers' register numbers are all checked up and corrected every two years, the cards being changed and new ledgers issued. This ensures consumers' register numbers being practically in rotation according to route at all times. Although this system may entail a little more work for the clerical department than the South Shields system, it furnishes a more accessible record of each consumer, and overcomes the objections which Mr. Toppin raises.

METER READER'S CARD.

Previous reading of meter.....

Date.	Wattmeter reading.	Read by	Date.	Wattmeter reading.	Read by

Date.	Cut.	Wattmeter No.	Size.	Const.

Location of meter.....

Name..... R. N. .....

Address..... Route.....

Mr. Smith having signed a contract for electric lighting, the necessary line orders are made out; on completion of the outside work the duplicate line order, properly filled out, comes back to the clerical department. The various cards are then made out; a meter-reading slip is filled in and put in the meter route loose-leaf book, according to the street number. One of the various meter service cards—incandescent, arc or motor—is made out and put into the meter box, according to the consumer's register number. A customer's data card is also made out, giving full particulars of the connected load, and placed in the customer's data box according to his register number. The entry is made in the ledger, merely putting in the name and address.

* Electrical Review, January 1st, 1909.

To each meter route there are allowed four pages in the ledger, each page holding 30 names. Meters are read every month and bills sent out monthly.

When making up routes afresh at the end of the second year in districts where there is likely to be a considerable gain, the ledger may be started with only 30 customers on that route. After meter-reading, the readings are transferred

REQUEST CARD.

Customer's No. .....

.....A.M.

Date.....

.....P.M.

	Rec'd by	Ret'd to	Date.
Customer's Card			
Light Card—Inc. Arc			
Po ver Card			
Contract—Lt. Pwr.			

from meter books to meter service cards. Now, supposing on route No. 1 there are 30 customers when the route is made up, their meter book slips and meter service cards come in rotation; two months later a customer may be taken on, who, for convenience in reading meters, is placed between

ALTERNATING ARC SERVICE.

R. N. .....

Name.....

Address.....

Date.	Cut.	Make.	Number.	Amp.	Volts.	Con.	Date.	Cut.	Make.	Number.	Amp.	Volts.	Con.

Date.	Reading.	Net reading.	Con.	Total. ....hours.	Max. demand.	Rate.	Gross bill.

slips No. 7 and No. 8, but in the meter service box his card would come after No. 30. This entails the clerk, after transferring No. 7, turning to No. 31 in the service box and then going back to No. 8 again. After all the service cards are made up, the gross amounts only are again transferred from the meter service cards to the ledger—this being straightforward work, as the ledger entries are always in numerical order with the service cards.

POWER SERVICE.

R. N. .....

Name .....

Address .....

Date.	Cut.	Make.	Number.	Amp.	Volts.	Con.	Date.	Cut.	Make.	Number.	Amp.	Volts.	Con.

Date.	Reading.	Net reading.	Con.	Total. ....hours.	Max. demand.	Rate.	Gross bill.

In connection with this system, the bills are addressed in an addressograph, all the stencils being numbered and arranged to correspond with the service cards. When a customer pays his bill, the numbered stub is removed; if the bill is paid in discount days, the discount is put on the stub. From the stubs the discount is entered up in the ledger. Then you have the two main items, gross and net monthly billings, which can be totalled up much faster in a ledger of this kind than in such a one as described by Mr. Petersen.

CUSTOMERS' DATA CARD—Meter Rate.

Name ..... R.N. .....

Address ..... Business .....

Incandescent Lamps.

Date.	Cut.	No.	C.P.	Total 16 c.p. equiv.	System.	Date.	Cut.	No.	C.P.	Total 16 c.p. equiv.	System.

Arc Lamps.

Date.	Cut.	No.	Size and type.	Total No.	System.	Date.	Cut.	No.	Size and type.	Total No.	System.

Motors.

Date.	Cut.	No.	H.P.	Total H.P.	System.	Date.	Cut.	No.	H.P.	Total H.P.	System.

Miscellaneous.

Date.	Cut.	No.	Description.	System.	Date.	Cut.	No.	Description.	System.

The one great objection to Mr. Petersen's system, it seems to me, is that you have either got to enter all the particulars as to rates and minimum charges on your meter cards, where they may become accessible to the public and are liable to become dirty and torn, or you have to enter them in your card ledger, which cannot be convenient, for if, at the time

INCANDESCENT—Meter Service Card—Accounting Department.

Name ..... R.N. .....

Address ..... Business .....

Installation.	Minimum charge.	Meter No.	Contract No.	Expires.

Date	Meter reading.	Net reading.	Con.	Total watt-hours.	Max. demand in.....	Rate.	Gross bill.	Disc.	Net.

bills are being made out, Mr. Smith comes into the office to "kick" about his rate or ask for a new rate, then the clerk using the ledger has to stop and look it up; or, again, if a new business department is in operation, too many employés will have to have access to the ledger.

In the system outlined above, if a canvasser wants information on Smith's rate or consumption, he fills in and signs a request card. The service card is then issued to

him, the request card being put in the box in place of the service card. The canvasser then has full data concerning Smith, and is directly responsible for the service card.

The second objection is, the size and number of loose-leaf ledgers required, and the time taken in totalling up. With the above system, 3,000 customers can be handled for two years' monthly readings in a ledger, the over-all dimensions of which are 20 in. long, 14 in. deep, and 3 in. thick.

In regard to Mr. Toppin's fear that cards may become lost, I might say that I have never heard of a card becoming lost during several years' use of this system; and should a meter-reading slip become detached, or a card lost, there would only be a little work entailed in making out a new one.

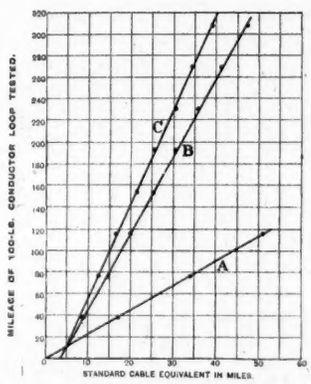
The various cards shown are, I think, self-explaining.

THE LOADING OF TELEPHONE CABLE CIRCUITS.*

By A. W. MARTIN.

(*Continued from page* 406.)

Experiment (*b*).—The same coils as were used in experiment (*a*) were next re-arranged so as to be at an average distance apart of 2·1 miles. Again, the actual distance between the coils in each loop varied about 60 per cent.



A, Cable unloaded; B, Loaded with air-core coils; C, Loaded with iron-core coils.

FIG. 17.—CABLE LOADED AT 2·1-MILE POINTS.

Table V shows the results obtained upon different lengths of each type of loaded circuit, and from these results curves B and C in fig. 17 have been drawn.

TABLE V.

Mileage of loop under test.	Standard cable equivalent in miles. Circuits loaded at 2·1-mile points	
	Air-core coil F.	Iron-core coil 507.
38·8	9·0	8·0
77·0	14·7	12·6
115·8	20·1	16·3
154·0	25·3	21·6
192·8	30·6	25·3
231·0	35·8	30·6
269·8	41·2	34·3
308·0	47·5	39·1

From the curves, the terminal loss and observed attenuation appear to be as follows:—

Air-Core Coil Loaded Loops.

Terminal loss = 3·7 M.S.C.

Excluding terminal loss, the loops are seven times better than standard cable. Observed attenuation constant = 0·103/7 = 0·0147 per mile.

Calculated β = 0·0147 per mile.

Coils per wave-length at 2,000 P.P.S. = 4·6.

Iron-Core Coil Loaded Loops.

Terminal loss = 3·8 M.S.C.

Excluding terminal loss, the loops are 8·7 times better than standard cable. Observed attenuation constant = 0·103/8·7 = 0·0118 per mile.

Calculated β = 0·0120 per mile.

Coils per wave-length at 2,000 P.P.S. = 4.

The quality of speech received over each type of loaded circuit was the same and very good.

Experiment (*c*).—The coils were redistributed in the loops so as to be at an average distance apart of 3·2 miles. In this case the actual variation in the spacing was 31 per cent. The following Table VI gives the standard cable equivalent values of the different loops as measured.

TABLE VI.

Mileage of loop under test.	Standard cable equivalent in miles. Circuits loaded at 3·2-mile points.	
	Air-core coil F.	Iron-core coil 507.
38·8	9·0	8·8
77·0	16·5	14·8
115·8	22·0	19·8
154·0	27·5	23·1
192·8	33·0	28·6
231·0	38·4	31·9
269·8	43·6	36·3
308·0	49·9	41·5

These results are shown graphically by the curves in fig. 18, and the conclusions, so far as observed results are concerned, are:—

Air-Core Coil Loaded Loops.

Terminal loss = 5·4 M.S.C.

Excluding terminal loss, the loops are 6·9 times better than standard cable. Observed attenuation constant = 0·103/6·9 = 0·0149 per mile.

Calculated β = 0·0160 per mile.

Coils per wave-length, at 2,000 P.P.S. = 3·7.

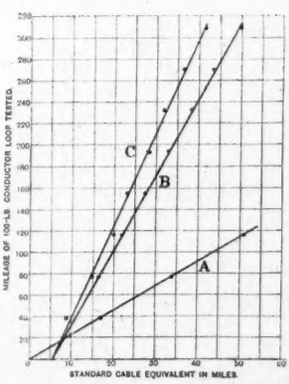


FIG. 18.—CABLE LOADED AT 3·2-MILE POINTS.

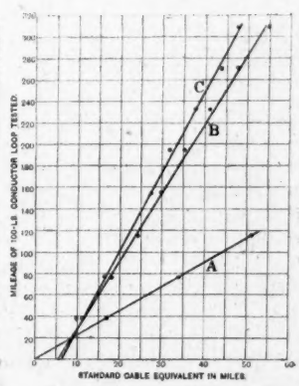


FIG. 19.—CABLE LOADED AT 4·3-MILE POINTS.

Iron-Core Coil Loaded Loops.

Terminal loss = 5·8 M.S.C.

Excluding terminal loss, the loops are 8·6 times better than standard cable. Observed attenuation constant = 0·103/8·6 = 0·0120 per mile.

Calculated β = 0·0131 per mile.

Coils per wave length at 2,000 P.P.S. = 3·3.

The speech transmitted over similar lengths of each type of loaded circuit was equally clear, and the articulation satisfactory.

Experiment (*d*).—Finally, the coils were inserted in the loops at a mean distance of 4·3 miles apart. The actual spacing between the inductances varied by 14 per cent. Table VII shows the measured standard cable equivalents of different lengths of each type of loaded loop.

Curves constructed from these results are shown in fig. 19, the deductions therefrom, respecting terminal loss and observed attenuation, being as follows:—

* A paper read before the Institution of Post Office Electrical Engineers on January 11th and February 8th, 1909.

Air-Core Coil Loaded Loops.

Terminal loss = 5·6 M.S.C.

Excluding terminal loss, the loops are 6·2 times better than standard cable. Observed attenuation constant = 0·103/6·2 = 0·0166 per mile.

Calculated β = 0·0172 per mile.

Coils per wave-length at 2,000 P.P.S. = 3·2.

TABLE VII.

Mileage of loop under test.	Standard cable equivalent in miles. Circuits loaded at 4·3-mile points.	
	Air-core coil F.	Iron-core coil 507.
38·8	9·8	11·0
77·0	17·9	16·8
115·8	24·2	23·9
154·0	30·0	27·5
192·8	35 2	31·9
231·0	41·2	38 0
269·8	47·5	43·7
308·0	54·8	47·5

Iron-Core Coil Loaded Loops.

Terminal loss = 6·6 M.S.C.

Excluding terminal loss, the loops are 7·5 times better than standard cable. Observed attenuation constant = 0·103/7·5= 0·0137 per mile.

Calculated β = 0·0143 per mile.

Coils per wave-length at 2,000 P.P.S. = 2·8.

In this case the speech received over either type of loaded circuit was of a very inferior quality—too bad, indeed, for commercial purposes.

(*To be continued.*)

REVIEWS.

Theoretical Elements of Electrical Engineering. By C. P. Steinmetz. Third edition, thoroughly revised. London: McGraw Book Co. 1909. Price $4.

It is now nearly eight years since the second edition of this book was published, and as it has been thoroughly revised and brought up to date, the more important additions to it are a good indication of the advances that have been made in electrical engineering during this period. In the additional matter we find, for instance, discussions of the theory of alternating-current railway motors, commutating poles (interpoles), converters having a variable ratio of conversion (split-pole converters), three-wire generators and converters, and the phenomena which characterise the short-circuit current of an alternator. It will be seen, therefore, that the additional matter greatly enhances the usefulness of the book to the electrical engineer.

In the preface, Prof. Steinmetz congratulates himself that none of the contents of the former editions had "to be dropped as superseded or antiquated." Whilst this affords legitimate grounds of satisfaction from the author's point of view, we are afraid that the student reader will be appalled at the magnitude of the task before him when he starts seriously to master this work. The same idea has apparently struck Prof. Steinmetz, for he encourages the student by telling him that "a large part of the mathematical discussion may be skipped," and so a general insight rapidly gained. In our opinion, it would have been advisable to give the reader some more definite information as to what cannot be skipped. Once a student begins skipping, he will always be haunted by an uneasy feeling that he has passed over something which would enable him to surmount the difficulties, which he meets, much more readily. The author's advice, therefore, that the reader should study at the same time the "Theory and Calculation of Alternating-Current Phenomena," is sound. But the necessity of reading an advanced work in order to understand the "Theoretical Elements" may strike some as a curious inversion of the order of things.

The first quarter of the book contains a general survey of electrical theory. The remainder is mainly an application of this theory to explain the working, and the problems underlying the design, of alternating-current apparatus.

In our opinion, the latter part of the book is the most valuable. In the "general survey" the intellectual food is given in tabloid form, and we are afraid that some of these tabloids may possibly cause acute indigestion to some who read the book carefully and ponder on what they have swallowed. To make this clear we shall illustrate how the extreme condensation of the theoretical principles in the early part of the book may give rise to difficulties in assimilation.

On page 2 we are told that an electric current represents a magnetomotive force, but on page 3 the product of amperes and turns is called magnetomotive force. The student, therefore, will be puzzled to know which definition to give. If he has read other books on the subject he may possibly think that the magnetomotive force is $4\pi/10$ times the ampere-turns, and he will naturally wonder what has become of the numerical coefficient in the author's definitions. If he is intelligent, he will see when he comes to page 22 that the author has modified the usual definition of reluctance, so as to make the numerical coefficient apparently disappear, but a word or two of explanation to this effect would be of great assistance to the ordinary reader.

On page 4 we read that "The magnetic field in the interior of a spiral (solenoid, helix, coil) carrying an electric current consists of straight lines." This can only be true, however, when the pitch of the spiral is small compared with its diameter. As we pull out the helix, it is obvious that the magnetic lines tend to become circles whose planes are perpendicular to the wire. To authors these facts are self-evident, but unless beginners are warned of the limitations of theorems, they are often led to take an unduly pessimistic view of their own reasoning powers.

The proof, on page 7, of the formula for the total flux between two parallel wires is not very clear. It is not obvious why the limits of integration are taken as $l_d/2$ and l_s, instead of $l_d/2$ and $l_s - l_d/2$. The latter limits would make the theorem rigorous, and the careful reader could then pass on with confidence to the next theorem.

On page 10, the resistivity of a material is defined to be a "constant of the material, varying with the temperature." We can hardly call something that varies a constant. Resistivity is usually defined as the resistance of a centimetre cube in microhms at 0° C. This may very well be described as a physical constant. If we wish to define resistivity in a more general way, it would be better to call it the "resistance coefficient" of the material varying with the temperature. This would bring it into line with "dielectric coefficient," which, for the same reason, is gradually displacing the phrase "dielectric constant." We are surprised that the author makes no mention of this coefficient in this book.

Prof. Steinmetz introduces novel definitions of "form factor" and "time constant." The Fleming definition of the form factor is that it is the ratio of the effective to the average value of the pressure. The definition has the merit of simplicity and the mathematician sees at a glance how it is to be determined. In the Steinmetz definition, it is the ratio of the actual effective pressure to the effective pressure when the wave is sine-shaped, the total flux per pole, or, in other words, the area of the waves, being the same in the two cases. We have now two waves to consider, and, at least at first sight, the problem is more complicated. The advantage of this definition is that the form factor is unity for a sine-shaped wave. With the ordinary definition, however, the form factor for a sine wave is 1·111 which is almost as easy to remember as unity, and we can also see at a glance that for a rectangular wave it is unity, and for a very peaky wave it is very large. We think, therefore, that the case for such a radical change in a definition which is now so widely adopted has not been made out.

In this book the "time constant" of a circuit is defined to be the ratio of the resistance to the inductance of the circuit. Its value, therefore, is the reciprocal of the ordinary time constant. The reason given for this change is that it simplifies certain mathematical formulæ. If this change be adopted we suppose that the time constant of a condenser K

shunted by a resistance R must be defined as $1/KR$ instead of KR. The advantages of doing this are extremely problematical, and there are several obvious disadvantages.

On page 61, a formula is given for the capacity of one wire of a transmission line, but no explanation is given of what is meant by the capacity of a single wire. Our notions on this point are extremely hazy, and, personally, we should have been grateful if the author had explained the connection between this "capacity" and the "capacity" of a condenser defined on page 59. We are quite certain that this is beyond the ability of the average reader, and it is unfair to leave such problems to the student. The formula obviously does not apply if the wires are close together. It would not apply, therefore, to three-core cables.

We have only noticed two misprints. On page 81, line 13, 3 is written for 0·3; and on page 277, 0·472 is written twice for 0·471.

We have read the book with great interest, and learned much from it, but we regard it more as a book of reference than as a text-book. It will be extremely useful to anyone who has to construct alternating-current machinery, or to lecture or write books in connection with this class of machinery. The student also well grounded in theory will find much novel and important matter in it. To the beginner, however, who is struggling painfully to get a clear insight into electrical theory, we cannot recommend it.—A. R.

Electric Power Conductors. By Wm. A. Del Mar. New York: D. Van Nostrand Co. London: Crosby Lockwood & Son. Pp. vi + 339 + 16. Price 9s. net.

The author of this book has had considerable experience in America of the design, installation, and maintenance of all kinds of electric power transmission systems, particularly on electric railways. Conclusions drawn from his own experience and that of others are set down, and the book forms to some extent an epitome of mains and cable practice. Such compilations as this are frequently of great value to those engaged in similar work.

The author's style, however, smacks of the note-book. He clips his sentences, such words as "the" frequently disappearing for whole paragraphs. He writes in Americanese, also, besides rending in twain nearly every infinitive that occurs. The proofs have not been read with sufficient care, many errors having been overlooked. Some of these are:—

p. 2, $\frac{\text{Aluminum}}{\text{copper}}$ for $\frac{\text{Aluminium}}{\text{copper}}$; p. 4, 4×6^6 for 4×10^6; p. 17, π for $\frac{\pi}{4}$; p. 28, weights for weighs; p. 37, terms for term; p. 52, Fihrenheit for Fahrenheit; p. 144, singe for single.

And so on, and so on, to the end of the book. Such cases as Stubb's (wire gauge) for Stubs's, are probably due to the author. In some cases a touch of "nu speling" is apparent, as "fiber," which word, by the way, he also renders as "fibre." We think that when an English publishing house takes up the sale of an American book in England, the book should be brought into conformity with English phraseology. The use of the archaic rendering "aluminum," which has been discontinued for many years in England, still endures in America, where they have not adopted the more euphonious "aluminium." The abbreviation "cm." is usually taken to mean "centimetre"; Mr. Del Mar uses it for "circular mil" as far as p. 116, after which he adopts "c.m."

We think it necessary to draw attention to these matters, for they make dull, and difficult to read, what should be an engrossing book.

The amount of information contained in the book is very great. Tables are given for every imaginable quantity which can be required in cable work. Calculations are given, and in the several appendices we are informed of the bases upon which the formulæ used are founded; we should like to see this done more often by writers for the practical engineer, whose confidence is sometimes sapped by jumbles of letters and figures which he only partly comprehends. In addition to the formulæ and their explanations numerical examples are given, which should prove useful.

There are good explanations, too, of the principles upon which experimental determinations depend, and the author has done wisely in making copious extracts from the work of others, in this connection. The notes on the Wheatstone bridge are due originally to the late Prof. Ayrton. Mr. Del Mar is careful to acknowledge the sources from which his extracts are taken.

Instructions on jointing are given. Some engineers of supply systems have instituted jointers' schools, and have found improved work to result. Mr. Del Mar does not lay sufficient stress upon the necessity of keeping full and careful records of all joints, so as to fix the responsibility when a breakdown occurs. For drawing-in cables he has not yet employed a traction engine, although this is a useful and economical method, capable of drawing-in lengths up to 180 yards, without manholes, if the pipes are laid with a bend in one direction only, and if the cables are jute covered, and served with hot compound when being covered.

Notes, calculations, and tables concerning the skin effect, which is of importance in alternating-current working, are both interesting and useful, besides being of rare occurrence. Herr E. Stirnimann suggested the use, for conductors having a greater cross-section than 100 sq. mm. (·155 sq. in.) of cables divided into a number of smaller cables, lightly insulated from each other, stranded together, and of not more than 70 sq. mm. (·109 sq. in.) section each. This practice, which deals effectively with both the skin effect and the effect of spiralling, has not been adopted to any great extent. While the author does not mention this solution, his mind has evidently worked along the same lines, as the reader will find.

Chapter IX deals with the subject of "depreciation." Probably the depreciation question has caused more argument between the expert engineer and the expert accountant than any other. Conclusions based upon practical experience are always welcome, and this chapter contains such conclusions.

Gauges and standards are laid down in such an arbitrary manner, as a rule, that it is rather refreshing to find that the American, or Brown and Sharpe, wire gauge has a systematic basis. Of this basis full details are given in Appendix I.

We think, perhaps, the reader might have been referred to existing text-books on algebra for the method of solution by determinants. Three pages are devoted to the subject. The word "susceptance" appears to be new. 1·345 is not, as is stated on page 295, the mean of 1·3 and 1·46.

Mr. Del Mar has given us, then, although in somewhat laborious style, a summary of manifold experience in transmission. He has gone very deeply into the question of conductors, insulation, maintenance costs, installation, overhead systems, and the effects upon them of weather conditions, underground systems, and all the variations which can be accomplished upon these things. His theoretical knowledge and his practical experience are both great. But let those beware who would trust too much to the experience of others, for, after 54 pages of elaborate making of formulæ, in the course of which he takes into account every detail, Mr. Del Mar closes his fourth chapter by saying: "It is thus obvious that the size of conductors is more a matter of judgment than of mathematics." Every mains engineer must be his own Daniel, and come to judgment upon his own conditions. There is still room for individuality.

Induction Generator Tests.—Experiments made by Messrs. T. Spooner and A. J. Barnes show that the induction generator has the following advantages: (1) With the most severe short circuit possible, it cannot be burnt out, and, therefore, it does not require the protection of circuit-breakers. (2) The large mechanical strains which occur when a synchronous generator is short-circuited, or when it is improperly synchronised, will not be produced in this type of machine. (3) As soon as a short-circuit is removed from the system, the induction generator may be immediately connected to the line, and it will take up its load, provided there is sufficient synchronous apparatus in operation to supply it with exciting current. Thus the time of shut-down can be greatly shortened because of the fact that it is not necessary to synchronise an induction generator before connecting it in parallel with other generators. To offset these advantages there is the following disadvantage: The induction generator must be run in parallel with some synchronous apparatus. Since the exciting current required by the induction generator is large, this synchronous apparatus must have a rating of at least 30 per cent. of that of the induction generator.

PROCEEDINGS OF INSTITUTIONS.

Short-Circuiting of Large Electric Generators and the Resulting Forces on Armature Windings.

By Miles Walker, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers, *Manchester, March 8th, and London, March 17th*, 1910.)

Alternate Current Generators.

If the armature of an alternator of ordinary regulating qualities is short-circuited while it is at rest, and the machine is then run at full speed and fully excited, the current in the armature will not rise to more than 2½ or 3 times its full-load value. The reason of this is that the current lags almost 90° behind the phase position of the pole centre, and it demagnetises the poles. This current would not be sufficient to bring into play any serious forces on the armature winding. But if an alternator while running at full speed and fully excited is suddenly short-circuited at the terminals of the armature, the current may rise to more than 20 times its full-load value. The first rush of current is propelled by the full E.M.F. of the generator, for there is no time in the first $\frac{1}{100}$ second for the field to be demagnetised. The rate at which the current rises is

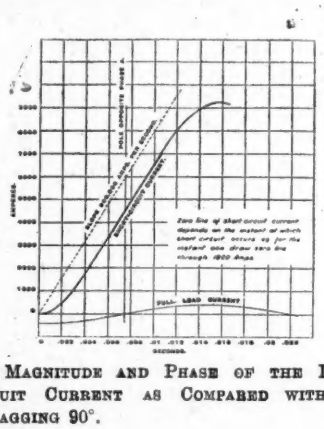


Fig. 1.—The Magnitude and Phase of the Instantaneous Short-Circuit Current as Compared with Full-Load Current Lagging 90°.

determined by the self-induction of the armature winding, due to the flux leaking between armature and field windings, and is affected by the distributed capacity between the winding and the frame.

The rate of the rise of the current is at first but little affected by the change of magnetic flux through the field magnet, because as the current in the armature rises, there is an eddy current in the pole-face, or even in the field-winding itself, which maintains the flux from the pole almost at its full value. It is only as this eddy current dies down that the armature demagnetises the field.

Now, the magnetic flux which leaks across the armature slots and around the end connectors due to full-load current, is often in turbo-generators only 5 per cent., and sometimes only 3 per cent., of the total flux from the poles, so it comes about that the rate of rise of the current in one of the phases which happens to be near its maximum E.M.F. at the instant of short circuit would, if the pole-flux were constant, be 20 or 30 times as great as the rate of rise from zero at full load. This, of course, assumes that the resistance and self-induction of the path of the eddy current in the pole is negligible. In practice these quantities must be taken into account.

A 5,500-KW. three-phase generator with four solid salient poles revolves at 1,000 R.P.M. The total flux per pole amounts to 78,000 kilolines; there are 27 conductors per phase per pole, and the instantaneous value of the E.M.F. generated in phase A at the

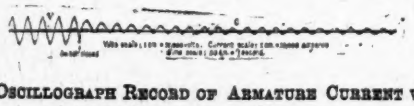


Fig. 2.—Oscillograph Record of Armature Current when an Alternator is Short-Circuited.

V = Voltage measured at terminals of the generator. To get the right phase of voltage in the leg of the star, reverse the polarity and subtract 30°.

Volts before short circuit = 3,900 virtual. Maximum current, 3,100 amperes.

moment when the pole is opposite phase A is 9,000 volts. The resistance of phase A is 0·056 ohm. For full-load current—288 amperes (= 405 amperes maximum)—the leakage amounts to 2,500 kilolines, or 3·2 per cent of the total flux per pole.

Let phase A be short-circuited at the moment above-mentioned. Fig. 1 shows generally the way that one would expect the short-circuit current to rise, leaving out of account the effect of the distributed capacity. The zero line of the current curve will depend upon the instant at which the switch closes. The figure also shows to the same scale the full load current lagging 90° behind the pole centre. As the pole gets past the middle position, the E.M.F. begins to sink and the resistances of the paths begin to make themselves felt when the current reaches several times its full load value. As the pole moves around, the eddy current moves along the pole face as though it were a reversed reflection of the current in the phase band A mirrored in the face of the pole. In a polyphase machine the cross magnetising and the demagnetising effects occur at the same time.

If instead of a solid pole we have a laminated pole, the resistance of the path for the eddy current is very much higher, but it is found that the exciting current in the winding is increased at the instant of short circuit, and takes the place of the eddy current in keeping the value of the pole-flux nearly constant for the instant after short circuit. Though the current may fall under the influence of the next pole, it does not always cross the zero line, but may describe a waving line which keeps its mean value above the zero line for several alternations. It may be said that at the instant of short circuit a direct current is generated in the winding which is maintained by the self-induction of the winding and slowly killed by the resistance. Superimposed on this direct current

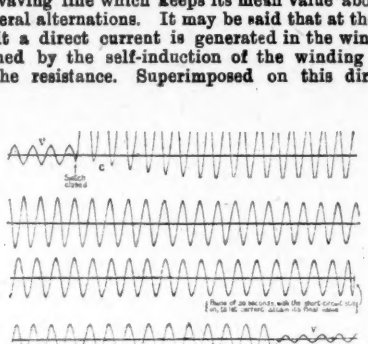


Fig. 3.—Oscillograph Record of Armature Current on Short Circuit, showing Rate at which the Current Decreases, and also the Way in which the Voltage Increases after the Short Circuit is Removed.

Scale of current, 1 cm. = 800 amperes.

is an alternating current generated by the passing of the poles alternating N and S, and at the same time gradually growing weaker as the eddy current in the pole-face or in the exciting windings grows weaker. After a few seconds the poles become normally excited and the current sinks to two and a half or three times its full-load value. In order to ascertain the instantaneous value of the current in the armature at the time of short circuit, some records were taken on a Duddell oscillograph fitted with a cinematograph film. Fig. 2 shows one of these records. The curve V shows the voltage before the short circuit, which in this case is 3,900 virtual, the maximum point being 5,700 volts. At the instant of short circuit the voltage at the terminals of the machine falls to zero and the current curve springs into being; the highest current recorded was 3,100 amperes. It will be seen that the current rises to such a high value during the first half of a cycle that the pole which passes during the next half cycle is hardly sufficient to bring it to zero. It then rises and falls in waves of gradually diminishing amplitude, until after a lapse of several seconds it assumes the value it would have had if the short circuit had been made before the field was excited. The value of the current at the first peak is about 32 times full-load current.

In order to get a better idea of the decrement of the wave of current, the oscillograph shunt resistance was changed so that the instrument would draw the smaller end of the curve on a larger scale. This is shown in fig. 3. In this case the peak of the current curve on short circuit is completely off the film, and it is only after several alternations that the amplitude is sufficiently diminished to bring the tops of the waves into view again. The film was stopped for several seconds to allow the armature current to assume its final value. This was 295 amperes, as recorded on an ammeter. It will be seen from this curve that even the 24th wave after the short circuit is 60 per cent. higher than the wave after it has settled down. Other oscillograms showed the effect due to the capacity of the winding.

Two interesting phenomena arose out of these experiments. It was noticed that the instant the oil switch was closed, which connected the terminals of the armature together, a ring of flame appeared at the ends of the field magnet. This flame was the more mysterious because the field magnet was flanked with a heavy bronze end bell at each end, and the ring of flame appeared on the face of this end bell, and had a diameter about 4 in. less than the bell itself. On inspection it was found that the bolts, at a distance of 2 in. from the circumference, which held the bell to the field magnet, were pitted where they pressed upon the bronze. The explanation appeared to be that the eddy current in the pole-face was so enormous that in passing to the end bell on its way to the next pole it made an arc between the bronze bell and the steel bolts. No one, without seeing it, would have believed it possible. The value of the eddy current can be roughly calculated, because we know that it is almost equal to the current in the armature wires, multiplied by the number of wires opposite the pole-face—in the case of these experiments about 150,000 amperes.

Another remarkable thing was the behaviour of the ammeter in circuit with the field magnet. From experience with other machines, one would have expected the field current to rise after the short-circuit. An increase in the current is easily understood when we remember that the armature suddenly applies a demagnetising force, and any diminution of the magnetism of the

pole creates a forward E.M.F. in the field winding which does not cease until the pole reaches its final weakened state. In the experiments on the machine with solid poles, however, the effect was reversed.

The field was excited from separately driven exciters feeding bus-bars at 125 volts, the current being controlled by a rheostat. The current before the experiment was adjusted to 70 amperes. For a moment after the short-circuit it remained almost stationary, and then quickly fell until it was only about 20 amperes. It then rose above its normal value, and it was not until after 7 seconds that it fell again to 70 amperes.

The explanation of the *decrease* in the exciting current in this case appears to be as follows: At the instant of short-circuit an eddy current is produced in the solid metal of the pole itself and this screens the field winding from any inductive action during the first second. The eddy current is produced on the surface of the pole, but gradually sinks into the body of the pole; the path of the current has now a coefficient of self-induction which is fairly great as compared with its resistance, because the magnetic lines produced by the eddy current lie in short closed paths in the iron of the pole. This eddy current in a path of such low resistance and high self-induction can easily subsist several seconds after the armature current has settled down to a small value. Thus after the powerful demagnetising effect of the armature is removed, the magnetising effect of the eddy current still exists, and, as it sinks into the body of the pole it takes the place of, or assists for the time being, the normal field current, causing this current to sink in value. In the course of time the resistance of the path kills the eddy current and the field current rises again.

This effect does not occur in a laminated pole. The demagnetising effect of the armature causes the field current to rise at the instant of short circuit.

If a copper damper is placed on the surface of the field magnet the eddy current appears mainly in this, and the field winding is screened more or less according as the resistance of the damper is less or more. In one case where a 1,000-KW. turbo-generator was short-circuited at full voltage, sparks were seen between certain parts of the metal of the damper which did not make perfect contact, showing that it is very necessary when dealing with the enormous currents which appear in a damper of this kind to see that the joints in the metal are made with the utmost care.

The study of the instantaneous currents which flow when an alternator is short-circuited is important on account of the great forces which they bring into play upon the armature windings. In fact, there has been considerable difficulty in the past in devising adequate means of supporting the coils. Even with slow-speed generators, it was known that the sudden rush of current which

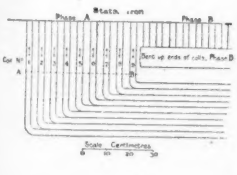


FIG. 4.

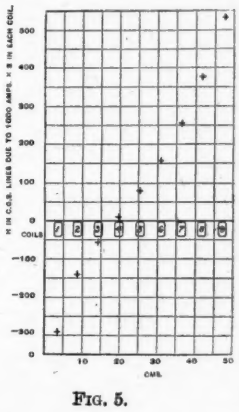


FIG. 5.

FIG. 5.—SHOWING STRENGTH OF MAGNETIC FIELD IN THE VARIOUS COILS DEPICTED IN FIG. 4 DUE TO 1,000 AMPERES IN EACH OF THE THREE CONDUCTORS WHICH MAKE UP ONE COIL.

occurred on short circuit, or when the generator was thrown on the bus-bars badly out of phase, would injure the winding unless it were made very strong and suitably supported. But it was not until after many serious accidents that the designer realised how many times greater were the forces he had to deal with in the case of turbo-generators. The reasons for the difference in this respect between slow-speed machines and turbo-generators are as follows: In the first place, the high-speed machine has comparatively few poles, and, therefore, the ampere-turns per pole are very much greater. For instance, a 3,000-KW. 25-cycle engine-type generator, running at 94 R.P.M., may have about 2,000 ampere-turns per phase per pole, while a 3,000-KW. 25-cycle turbo-generator, running at 1,500 R.P.M., may have as many as 8,000 ampere-turns per phase per pole. The force is proportional to the square of the current, so that four times as many ampere-turns will give us many times as much force, even though the coils are broader.

Secondly, the span of the coils in the engine-type machine is very much shorter. In the machines compared above, the spans of the coil might be 18 in. in the one case and 90 in. in the other.

Then, again, the magnetic flux leakage across the slots and around the end windings bears a much smaller ratio to the total flux per pole in the case of many turbo-generators than it does in the case of engine-type machines. This consideration, as we have seen above, is one that determines the value of the current on short circuit.

The troubles that were experienced in the early turbo-generators were, no doubt, partly due to the disinclination on the part of the designer to bring the high-tension winding very near to metal clamps. Experience had shown that it was desirable to preserve long creepage distances and to keep coils of different phases as far away from each other as possible; any clamping that had to be done was done in accordance with old-established rules of insulation. The result was that in many cases the clamping was insufficient.

It is interesting to take an arrangement of coils and to calculate what forces are at work on various parts, assuming that the current at the instant of short circuit is 32 times as great as the normal full-load current. Fig. 4 shows the plan of a coil of an old-fashioned winding which was completely wrecked by the throwing of a generator on to the bus-bars when it was out of step. The direction of the current in the windings is shown by the arrows. Fig. 5 is a diagram showing the intensity of the magnetic field at various parts of the winding along the section A-B, when 1,000 amperes is flowing in each conductor. This diagram has been arrived at by a summation of the values of the field produced by different conductors at every point along the section A-B. It will be seen that the magnetic field at point B is as great as 530 C.G.S. units. If at this point we have three conductors, each carrying a current of 1,000 amperes, the force on the armature coil will be 11·2 lb. per foot run. Now the force increases as the square of the current: so with 10,000 amperes per conductor (if we add a little for the capacity effect, the current works out at something over 9,300 amperes) the force would be 100 times as great, that is to say, 1,100 lb. per foot run for the worst coil. Even this great force, if it acted slowly, would not have caused as much bending as had apparently taken place. But when a force acts on a beam quickly, it can produce by the swing double the amount of deflection it can produce when acting slowly. Taking this swinging action into account, the twisting of the coils can be explained. Still the work of the destructive forces in these cases is so startling in its nature that one wonders at times if materials retain their ordinary mechanical properties when subjected to these sudden electromagnetic forces. For example, some blocks of maple wood having a section 6 in. × 8 in. placed between the bent-up coils and the iron end-plate, were crushed to splinters as if they had been under the blows of a steam hammer. Experiments were made on an insulated coil to see what bending forces it would stand without destruction. The experiments were made on the coil when it was cold, and it was found that the stiffness of the coil was very much greater than the calculated stiffness, taking into account the copper conductors only, showing that the coil derived a great part of its strength from the insulation. This is interesting, because one does not ordinarily expect insulation to have very great mechanical strength. It would have been better had the test been carried out with a warm coil.

If two similar alternators running at full speed and fully excited are thrown in circuit with one another when directly out of step, the current which flows through the armature is the same as if each machine had been short-circuited at its terminals. The E.M.F. taken in the whole circuit of the two machines is doubled, and the resistance and self-induction are also doubled. If the machines are thrown into circuit only partly out of step, the current which circulates is not so great, being equal to the short-circuit current multiplied by the sine of half the angle of phase displacement between the two machines. The maximum effect will be obtained where a machine is switched on to a bus-bar fed by a very large number of generators. In this case, the current might rise to almost double the value it would attain on a dead short circuit, *i.e.*, the forces which would come into play would be nearly four times as great.

It will be seen that when we are dealing with forces of many hundreds of pounds per foot run, especially when many coils are grouped together, very strong clamps are necessary to keep the windings in position. The old plan of tying coils together with torpedo twine and securing them with wooden blocks is wholly

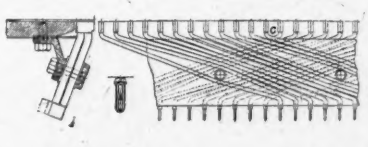


FIG. 6.—BARREL WINDING OF STATOR SUPPORTED BY INTERNAL RING OF METAL BOLTED TO BRACKETS.

insufficient. One cannot hope to make a satisfactory construction without using strong metal clamps. This necessitates insulating the whole of the winding outside the slots with an insulation which is not only strong enough to withstand the whole testing pressure, but is of such a good mechanical nature that it will not be crushed under the pressure of the clamps.

It is convenient here to consider the various types of end connectors which are commonly employed on the windings of turbo-generators.

There is first the barrel winding, in which all the coils are of the same shape and fit against one another, forming a continuous lattice-work (see fig. 6). The advantage of this type of winding is that the field produced by some of the conductors is to a certain extent neutralised by the field produced by conductors lying near, so that the magnetic field over a great part of the coils is not as great as

with other types of winding. The magnetic field, however, at the point *c* in fig. 6 is as great as with any other type, and at this point the coil is difficult to support. With this winding the conductors

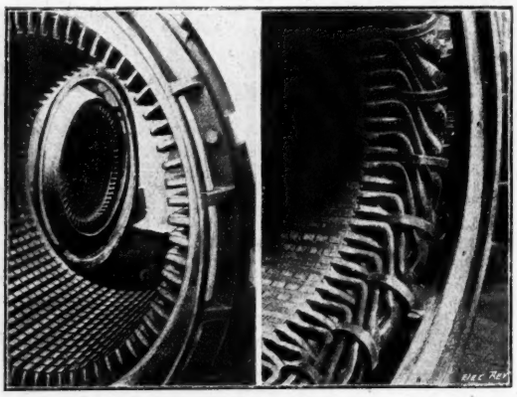


Fig. 7.—Cast-Metal Ring for Supporting Winding (B.T.-H. Co.).

Fig. 8.—Method of Bracing Coils to Cast-Metal Supporting Ring (B.T.-H. Co.).

belonging to different phases lie next to one another, and it is very necessary to insulate the coil throughout its whole length with insulation strong enough to resist full pressure to earth. It is usual to impregnate the coils as a whole, and to place them in open slots, the coils being secured by wedges in the top of the slots. Various methods are employed to secure the parts of the coils lying outside the slots. One very good method, employed by the British

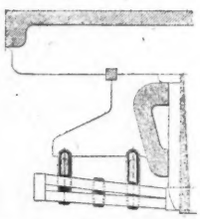


Fig. 9.—Supporting Rings for Barrel Winding (British Thomson-Houston Co.).

Thomson-Houston Co., is shown in figs. 7 and 8. A very substantial ring, supported on brackets, and cast with them, is provided immediately behind the winding. This ring is well insulated, and the

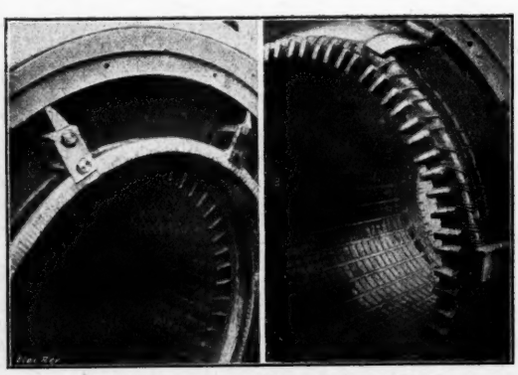


Fig. 10.—Insulated Supporting Rings.

Fig. 11.—Method of Lashing Rings to Bar Winding (B,T.-H. Co.).

formed winding is braced to it by means of circular metal bands placed over wooden clamps which are shaped to hold the coils. Figs. 9, 10 and 11 illustrate another method employed by the same firm for securing a barrel-wound armature. Here there are two rings wound with a considerable thickness of insulating material, and held by brackets cast with the frame. These rings have some portions cut away, and it is thus possible to put them into the notches in the brackets, and after turning them through a small angle on their principal axis, to lock them at a point where the diameter is rather larger. The winding is then put into the slots and braced to the insulated rings, as shown in figs. 11 and 12.

Another type of winding is shown in figs. 13 to 18. In this case the coils are concentric and are placed in two or three ranges, each phase being separated from its neighbour, and in addition to the

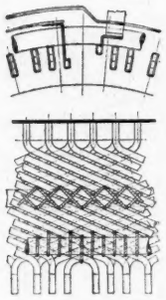


Fig. 12.

insulation on the coils, thick insulating blocks can be placed so as to separate all points between which a high voltage exists. This winding has the following advantages:—The part of the coil

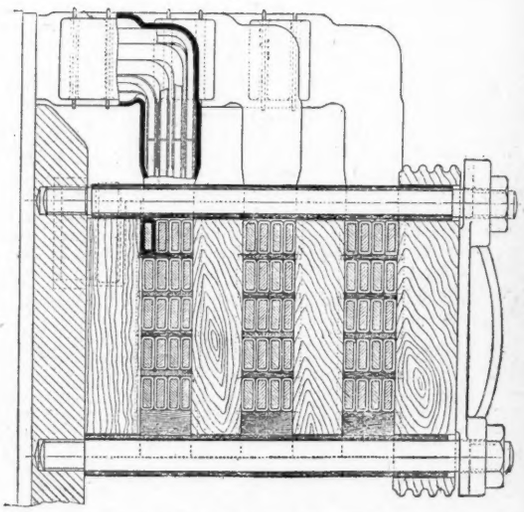


Fig. 13.—Concentric Coil Winding in Three Tiers made with Rectangular Strap and Bolted to End Plate (British Westinghouse Co.).

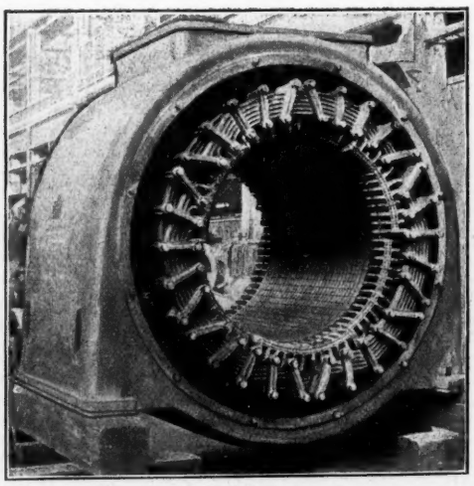


Fig. 14.—British Westinghouse Co.'s System.

lying in the slot can be made of perfectly straight conductors insulated with mica, or mica and paper impregnated and compressed so as to exclude all air from its composition. These operations can be much more satisfactorily carried out on a straight coil. After the straight part is placed in the slots, the ends can be

connected by connectors which have been previously insulated, and the insulation of the joints can be carried out with tape and varnish in a thoroughly satisfactory manner. If ever it should be necessary to make a repair on the machine, a coil of this kind can be

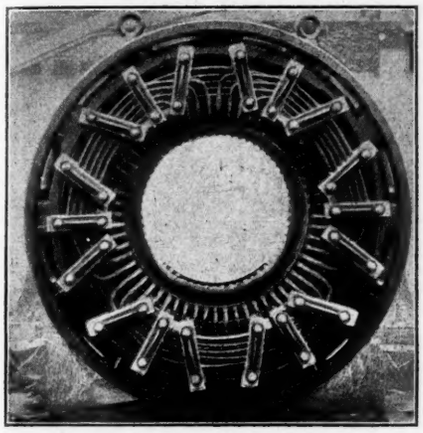
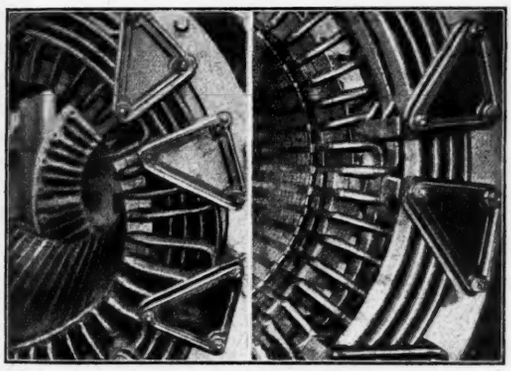


Fig. 15.—Bruce Peebles Winding.

taken out of the slot without interfering with the rest of the winding. The end connectors, which are subjected to the great forces on short circuit, can be made of much thicker material than the remainder of the coil, and the shape of the section may be so



Figs. 16 and 17.—Brush Co.'s Winding.

designed as better to resist the mechanical forces. However strong the conductors themselves may be, reliance must mainly be placed on strong metal clamps to resist forces due to a dead short circuit. Cases are on record where even the clamps, held by 1-in. studs, have

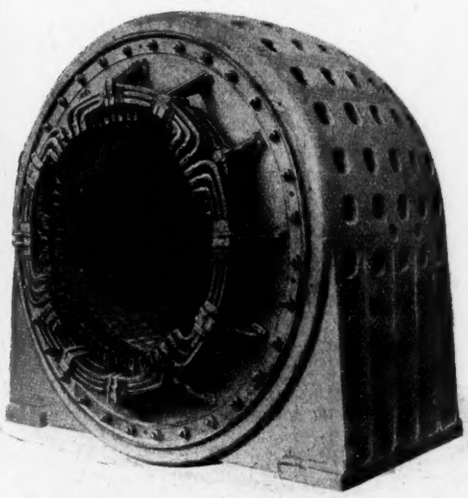
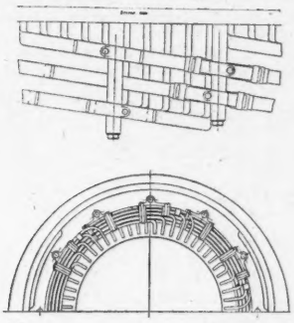


Fig. 18.—Dick, Kerr Winding.

been forced out of position and the winding wrecked. The clamps shown in fig. 13 are made by screwing bronze bolts into a cast-steel end-plate, a metal beam of a section designed to resist great forces is screwed down by means of nuts on the winding, and the various ranges are separated by hard wood blocks. In addition to the blocks between the ranges, wooden blocks are secured between the coils on those parts where they emerge from the slots and also on the corners. Experience has shown that a winding of this kind, if carried out according to the best practice, is able to withstand repeated short circuits without any budging of the coils.

Fig. 13 shows the winding on the 6,000-K.V.A. 11,000-volt generators of the Underground Electric Railways Co. at Chelsea. This winding replaces the older winding shown in fig. 4. It has been in service for four years, and has not given any trouble either from want of insulation or from distortion due to excessive



Figs. 19 and 20.—Imbricated Winding with External Clamps.

mechanical strains. Fig. 14 shows the winding of the 6,000-K.V.A. generators built for the London County Council. It is of the same type as fig. 13, except that there are only two ranges instead of three. It illustrates well one of the latest methods of supporting armature coils.

Fig. 15 shows a turbo-generator by Bruce Peebles & Co., also with coils in two ranges and fitted with strong clamps. Figs. 16 and 17 give two views of the winding of a 2,000-KW. 25-cycle 5,500-volt turbo-generator built by the Brush Electrical Engineering Co. Here the clamps are made triangular in shape, and held by three studs. Fig. 18 illustrates a winding by Dick, Kerr & Co., which has been very successful in operation.

The winding illustrated in figs. 19 and 20 is of a rather different type. Instead of having two or three distinct ranges lying in different planes, the coils are placed obliquely and are imbricated one over the other. When secured by suitable clamps this winding can be made very strong and satisfactory.

(To be continued.)

Wireless Telegraphy and Meteorology. — Various experiments were made during 1909 under the joint auspices of the English and German Governments in the direction of transmitting to Europe weather observations made on ships in the Atlantic Ocean, with a view to their being rendered of advantage to meteorology. After preliminary trials made in 1907, the director of the Meteorological Observatory at Aix-la-Chapelle undertook in 1908 a trip on the *Kaiserin Auguste Viktoria*, of the Hamburg-American Line, for the purpose of testing the time required for the transmission of telegrams from land to the ship, and ascertaining whether it was possible to obtain information on the ship concerning the condition of the weather on the ocean. In 1909, on the other hand, the trials were made in conjunction with vessels proceeding over the ocean in the sense of the observations being forwarded from the ships to the land, and with the object of determining whether the news would be of advantage for meteorological purposes. The tests were made between February 1st and April 30th, and between August 1st and September 30th. The observations, which are said to have been made on all ocean-going ships, were transmitted to the Meteorological Institution, London, the German Seewarte at Hamburg, and the Weather Service Bureau, at Aix-la-Chapelle. It is stated that as a result of the experiments, it was found that an extension of weather charts to the ocean was of advantage for such a service. Thus, according to the report issued by the Seewarte, the possibility already exists of deriving benefit from predictions of weather by the extension of atmospheric pressure charts through the transmission of wireless telegrams. As, however, evening weather charts could only be projected in the winter time, owing to an evening service only existing during the cold period of the year, it was impossible to utilise the observations made in the evening during a large part of the tests. Only comparatively few of the morning observations arrived in time up to the settlement of the weather service for the same day, although it is probable that a large number of observations from the preceding evening were on hand. As to a regular organisation for the transmission of weather observations by wireless telegraphy from the ocean, it is considered that this must be associated with a regular working-up of the observations of the European stations from the previous evening. The report of the Seewarte concludes that patience must still be exercised in regard to the successful extension of the weather charts in respect of the east of the Atlantic Ocean, but that each test represents an appreciable gain, as it throws full light on what is achievable in this way at the present time.

NEW PATENTS APPLIED FOR, 1910.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

5,594. "Unidirectional-current machines." C. F. Barnholdt. March 7th.

5,623. "Reflecting electric light bulbs and globes, gas and incandescent gas globes and chimneys, lamp globes and chimneys." D. Lamont.

5,639. "Improved terminal piece for fixing to wires or cables to enable them to be joined or coupled together." A. Groves. March 7th.

5,641. "Improvements in and relating to electric fire-alarm apparatus and the like." H. Knight. March 7th.

5,652. "Improvements relating to constant current dynamos." A. Hill and Trier & Martin, Ltd. March 7th.

5,654. "Improvements in and relating to insulators for supporting the current rails or conductors of electric railways, tramways, and the like." A. Watkins. (Application for Patent of Addition to No. 21,526, 1909.) March 7th.

5,659. "Improvements in or relating to electric lighting arrangements." H. T. Harrison. March 7th.

5,660. "Improvements in electric arc lamps." H. Malachowski. (Date applied for under Sec. 91 of the Act, July 30th, 1909, being date of application in Germany.) March 7th. (Complete.)

5,684. "Magnetic separator." G. Rietkötter and A. Kuhn. March 7th. (Complete.)

5,691. "Improved process for producing porous electro-deposits." W. E. Lake. (Fabrik Elektrischer Zünder G.m.b.H., Germany.) March 7th. (Complete.)

5,700. "Improvements in the wet magnetic separation of minerals." Murex Magnetic Co., Ltd., A. A. Lockwood. March 7th.

5,717. "Improvements in or relating to telephone mouthpieces and the like." A. E. Lamkin and L. Hunter. March 7th.

5,735. "Improvements in pendants for electric lamps and gas burners." A. Docking. March 8th. (Complete.)

5,747. "Improvements in insulating cups for telegraph, telephone and other electric wires." R. J. Adams. March 8th.

5,765. "Improvements in motor-starting and controlling apparatus." J. A. Hirst and P. S. Brook. March 8th.

5,766. "Improvements in the time-limit overload devices for actuating the no-volt release devices of circuit-breakers and motor-starters." J. A. Hirst and P. S. Brook. March 8th.

5,801. "Improvements in electro-magnetically-actuated electric switches." Adams Manufacturing Co., Ltd. (Cutler Hammer Manufacturing Co., United States.) March 8th. (Complete.)

5,818. "Improvements in and relating to electric safety lamps for use in mines or other places." J. G. Patterson. March 8th.

5,823. "Improvements in or relating to thermopiles or thermo-electric couples." F. N. Davidson. March 8th. (Complete.)

5,823. "Automatic electric switching mechanism." J. J. Fanning and T. F. Nellis. March 8th. (Complete.)

5,835. "Improvements in insulating wall boxes for electric apparatus." E. Neudörfer. March 8th. (Complete.)

5,865. "Improvements in apparatus external to switch." L. G. Flory. March 9th.

5,896. "Improvements in methods of and means for obtaining continuous currents from alternating current circuits." A. M. Taylor. March 9th.

5,900. "Electrically driven hand cutting out machine." S. Schwarzschild. March 9th.

5,902. "Improvements in and relating to electric fire detectors and alarms." H. Hawthorn. March 9th.

5,917. "Improved rectifier for high-tension alternating currents." Siemens and Halske Akt.-Ges. (Date applied for under Sec. 91 of the Act, May 28th, 1909, being date of application in Germany.) March 9th. (Complete.)

5,926. "Improvements in and relating to the sockets of incandescent electric lamps." C. G. M. Bennett. March 9th.

5,934. "Improvements in and apparatus for the production and maintenance of long electric arcs." G. W. Johnson. (Chemische Fabrik Griesheim Elektron, Germany.) (Application for Patent of Addition No. 11,060, 1909.) March 9th.

5,954. "Improvements in or relating to the electro-plating of metal articles." H. L. Sulman, H. F. K. Picard and F. H. Wintle. March 9th.

5,965. "Improvements in or relating to electric arc lamps." Jandus Arc Lamp and Electric Co., Ltd., A. D. Jones and P. V. Castell-Evans. March 10th.

5,985. "Improvement in or relating to alternating-current induction motors." W. I. Smith, J. D. Green and A. W. Glover. March 10th. (Complete.)

6,033. "Improvements in rotary contact-breakers for magnetos with dual ignition." H. Weckerlein and H. Stocker. March 10th. (Complete.)

6,035. "Methods of and means for charging electric resistance furnaces." A. Petersson. (Date applied for under Sec. 91 of the Act, June 2nd, 1909, being date of application in Sweden.) March 10th. (Complete.)

6,057. "Improved index sheet or disk for use in connection with telephones." F. R. Brighten. March 10th.

6,068. "Improvements in apparatus for carrying out the electrolytic production of sodium." Societe d'Electro-Chimie and P. L. Hutin. (Date applied for under Sec. 91 of the Act, May 6th, 1909, being date of application in France.) March 10th. (Complete.)

6,085. "Improvements in electric water heaters." M. V. Ely and Foster Arc Lamp and Engineering Co., Ltd. March 10th.

6,101. "Improvements in sparking plugs for internal explosion engines." R. H. Hall. March 11th.

6,124. "Improvements in or relating to alternating-current commutator electric motors." Siemens Bros. Dynamo Works, Ltd (Siemens Schuckertwerke G.m.b.H., Germany). March 11th. (Complete.)

6,125. "Improvements in or relating to the regulation of electric frequency converters." Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke G.m.b.H., Germany.) March 11th. (Complete.)

6,132. "Improved locking device for electric lampholders." H. Brooker and W. A. Hooper. March 11th.

6,154. "Improved means for electrically lighting gas burners." M. Delage and P. Wood. (Date applied for under Sec. 91 of the Act, March 11th, 1909, being date of application in France.) March 11th. (Complete.)

6,160. "Improvements in and relating to electric switches." Adams Manfacturing Co., Ltd. (Cutler-Hammer Manufacturing Co., United States.) March 11th. (Complete.)

6,168. "Improvements in or relating to the electro-plating of metal articles." H. L. Sulman, H. F. K. Picard and F. G. Wintle. March 11th.

6,190. "Improved means for locking nuts on insulator attachments of telegraph poles and for other like uses." B. Bishop. March 12th.

6,191. "Improvements in electric lamp holders and lamp caps for same." J. W. Ewart. March 12th.

6,196. "New or improved method of wiring for electrical purposes in ships, yachts, and the like, and improvements in or connected with conduits therefor." W. Bell. March 12th.

6,207. "Improvements in or relating to electrically heated appliances or apparatus for domestic or other purposes." C. O. Bastian. March 12th.

6,212. "Electro-magnetic apparatus applicable to machinery, vehicles and the like." F. Meguin & Co., A.G. (Date applied for under Sec. 91 of the Act, March 12th, 1909, being date of application in Germany.) March 12th. (Complete.)

6,256. "Electrical speed indicator for measuring the speed of rotating shafts and indicating the sense of the rotation." S. Landi. March 12th. (Complete.)

6,272. "Improvements in single-phase commutator machines." Allmanna Svenska Elektriska Actiebolaget. (Date applied for under Sec. 91 of the Act, August 2nd, 1909, being date of application in Sweden.) March 12th. (Complete.)

6,292. "Protective or indicating devices operative on leakage currents for use in continuous-current transmission and distribution systems." British Thomson-Houston Co., Ltd., and E. B. Wedmore. March 12th.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1909.

Electroplating Apparatus. C. G. Backus. 8,784. April 13th. (Date applied for under International Convention, April 13th, 1908.)

Electric Circuit Closers. J. H. Kennedy-McGregor. 9,094. April 17th.

Electric Fan Motors. A. Hirst and A. J. D. Krause. 9,706. April 23rd.

Protective Devices for Alternating-Current Systems. H. Brazil and H. Cooch. 10,663. May 5th.

Manufacture of Junction Fittings of Metallic Conduits for Electric Conductors. Charles H. Pugh, Ltd., and G. F. Bull. 10,739. May 6th. (Post dated May 6th, 1909.)

Regenerators for use in the Electrozincing Process. S. O. Cowper-Coles. 11,844. May 19th.

Electric Switches. W. D. R. MacDiarmid and E. B. Bates. 12,335. May 25th.

Brush Holders for Dynamo-Electric Machines. M. A. McLean. 12,774. May 28th.

Distributing Box for Underground Cables with Multiple Electrical Conductors. R. Monnier. 13,129. June 4th. (Date applied for under International Convention, June 6th, 1908.)

Electric Arc Lamps. O. Millauro. 14,165. June 16th.

Electrical Heating Apparatus. A. D. Berry. 17,353. July 26th.

High-Tension Magnets. T. M. Mueller. 17,663. July 29th. (Date applied for under International Convention, August 4th, 1908.)

Process for Regenerating Electric Accumulators. J. Friedrich. 19,111. August 19th.

Electric Switching Devices for Controlling Electromagnetic Clutches. D. Dusseris. 20,413. September 7th.

Dynamo Brush Holders. O. Höhme. 21,276. October 22nd.

Combination Coupling for Electric Conductors. L. M. Waterhouse. 24,771. October 28th.

Telephone Exchanges. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 21,512. October 28th.

Conduit Fittings for Electrical and Other Purposes, and the Manufacture of same. A. Brampton and F. Osborne. 24,892. October 29th. (Date applied for under Rule 13, April 10th, 1909.)

Tumbler Switches. J. J. Rawlings. 27,446. November 25th. (Date applied for under Rule 13, January 7th, 1903.)

Electrical Means for Protecting Ships' Bottoms from Barnacles and the like. J. E. James. 279. January 5th. (Post dated May 5th, 1909.)

Supports of Overhead Electric Cables and the like. G. H. Bowden, F. C. Anderson, C. A. Atchley and G. Bull. 813. January 13th.

Attachment Device for the Shades of Electric Lamps and the like. W. Crookell. 3,195. February 9th. (Post dated August 4th, 1909.)

Electrical Heating Devices G. Kolemine. 3,709. February 15th. (Date applied for under International Convention, March 19th, 1908.)

Telephones. C. A. Adams-Randall. 3,717. February 15th.

Apparatus for use in Systems of Train Lighting by Electricity. Siemens Bros. Dynamo Works, Ltd., F. G. Broadhead and S. Hawkins. 3,906. February 17th.

Armouring Electric Cables. E. Witzenmann. 3,917. February 17th.

Call Signal Devices for Telegraphic and Railway Electric Signalling Apparatus with the use of Pulsating Currents. W. Roubanowitsch. 3,983. February 17th.

Contact Breaker for Magneto-Electric Sparking Apparatus for Internal Combustion Engines. Unterberg & Helmle. 4,030. February 18th. (Date applied for under International Convention, August 8th, 1908.)

Electric Switches. British Thomson-Houston Co. (General Electric Co.) 4,250. February 20th. (Request under Sec. 19 not granted.)

Continuous-Current Dynamo-Electric Machines. W. Buchanan. 4,374. February 22nd.

Controllers for Dynamo-Electric Motors. Allgemeine Elektricitäts Ges. 4,472. February 24th. (Date applied for under International Convention, February 24th, 1908.)

Production of Magnets from Cast-Iron. F. Burks. 5,360. March 5th.

Electrical Arrangements with Horological Pendulums and Balances. A. V. Prior. 5,637. March 9th.

Metal Casings of Electric Fuse Boards. V. Hope. 6,049. March 13th.

Automatic Electrical Depth Recorder. D. Ireland. 6,574. March 19th. (Post-dated September 1 th, 1909.)

Electric Light or Gas Illuminating Frame for Lighting from the Front during Dark Hours any Object Enframed. F. Geller. 6,601. March 19th.

Appliances for Cooking by Electricity. I. V. Hosgood. 7,029. March 24th.

Slow-Motion Device for Operating Switches. F. J. Moffett and N. B. Risher. 7,053. March 24th. (Post-dated September 24th, 1909.)

Electric Switches. O. Baker. 8,025. April 3rd.

Transmitters for Wireless Telegraphy. G. Marconi and Marconi's Wireless Telegraph Co. 8,532. April 8th. (Application for Patent of Addition to No. 20,119, of 1907.)

Means of Locking Electric Incandescent Lamps to their Holders. E. P. Cottier. 9,194. April 19th.

Electrochemical Production of Phosphatic Fertilisers. G. Levi. 18,493. August 10th.

Adjustable Transformers for Polyphase Electric Alternating Currents. Siemens Bros. Dynamo Works. (Siemens Schuckertwerke Ges.) 20,003. September 1st.

Automatic Selective Switching Apparatus Suitable for use in Telephone Systems. J. E. Kingsbury. (Western Electric Co.) 20,842. September 11th.

Manufacture of Iron Poles for Telegraphs, Telephones and the like. J. H. Skinner. 21,222. September 15th.

Ignition Contrivances of Internal Combustion Engines. A. Gray. 21,858. September 24th.